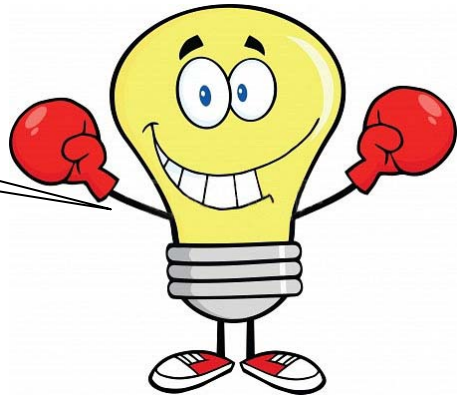
We're on a roll! Bring on Exam II!



Bl 121 Lecture 16

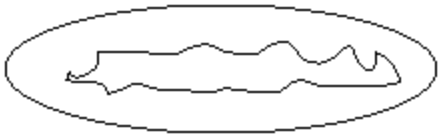
I. ***Announcements*** **Notebooks? Exam II, December 8th Monday 8 am. Review session in class next Thursday. Q?**

II. ***Muscle Adaptation Connections*** **LS ch 8, DC Module 12**

III. ***Respiratory System*** **LS ch 12, DC Module 7, Fox +...**

- **A. Steps of respiration? External *vs.* cellular/internal? LS fig 12-1 pp 345-347**
- **B. Respiratory anatomy LS fig 12-2 p 347, DC, Fox +...**
- **C. Histology LS fig 12- 4 pp 347-349, DC**
- **D. How do we breathe? LS fig 12-12, fig 12-25 pp 349-356, pp 373-378**
- **E. Gas exchange LS fig 12-19 pp 362-5**
- **F. Gas transport LS tab 12-3 pp 365-70**

AEROBIC w/O_2



MITOCHONDRIA

ANAEROBIC

CYTOSOL

Glycolysis

Immediate/ATP-PC

PRIMARY FUEL	ACTIVITY	% AEROBIC (Oxidative Energy System)	% ANAEROBIC (Immediate & Non-Oxidative Energy Systems)	TIME (Min:Sec)
	Marathon Cross-Country Skiing	100	0	135:00
	10-K Run	90	10	29:00
FAT, CARBOHYDRATE & PROTEIN (Small Amounts)	3-Mile Run	80	20	14:00
	2-Mile Run 800-Meter Swim	70	30	
		60	40	9:00
	1-Mile Run			3:45
CARBOHYDRATE (Glucose & Glycogen)	Boxing 200-Meter Swim	50	50	
	Circuit Weight Training	40	60	
	Soccer Lacrosse	30	70	1:30
	Tennis	20	80	0:50
ATP, ADP & Creatine Phosphate (CP)	Basketball Volleyball 200-Meter Dash Football	10	90	0:20
	Conventional Weight Training	0	100	0:10

Characteristics of Skeletal Muscle Fibers

Characteristic	TYPE OF FIBER		
	Slow Oxidative (Type I)	Fast Oxidative (Type IIa)	Fast Glycolytic (Type IIb)
Myosin-ATPase Activity	Low	High	High
Speed of Contraction	Slow	Fast	Fast
Resistance to Fatigue	High	Intermediate	Low
Aerobic Capacity	High	High	Low
Anaerobic Capacity	Low	Intermediate	High
Mitochondria	Many	Many	Few
Capillaries	Many	Many	Few
Myoglobin Content	High	High	Low
Color of Fibers	Red	Red	White
Glycogen Content	Low	Intermediate	High

LS 2012 tab 8-1 modified
> VP Lombardi 1989

Changes in Muscle Due to Strength Training

- ↑ Size of larger fast vs smaller slow fibers
- ↑ CP as well as creatine phosphokinase (CPK) which enhances short-term power output
- ↑ Key enzymes which help store and dissolve sugar including glycogen phosphorylase (GPP) & phosphofructokinase (PFK)
- ↓ Mitochondrial # relative to muscle tissue
- ↓ Vascularization relative to muscle tissue
- ↑ Splitting of fast fibers? Hyperplasia? With growth hormone (GH), androgenic-anabolic steroids (AAS)?

Changes in Muscle Due to <u>Endurance Training</u>

- ↑ Mitochondria, # & size
- ↑ Mitochondrial (aerobic) enzymes including those specific for fat burning
- ↑ Vascularization of muscles (better blood flow)
- ↑ Stores of fat in muscles accompanied by
- ↓ Triglycerides/fats in bloodstream
- ↑ Enzymes: activation, transport, breakdown (β-oxidation) of fatty acids
- ↑ Myoglobin (enhances O_2 transport)
- ↑ Resting energy levels which inhibit sugar breakdown
- ↑ Aerobic capacity of all three fiber types.

Which end of continuum?

+

Which energy nutrient/s?

+ Which specific muscles?

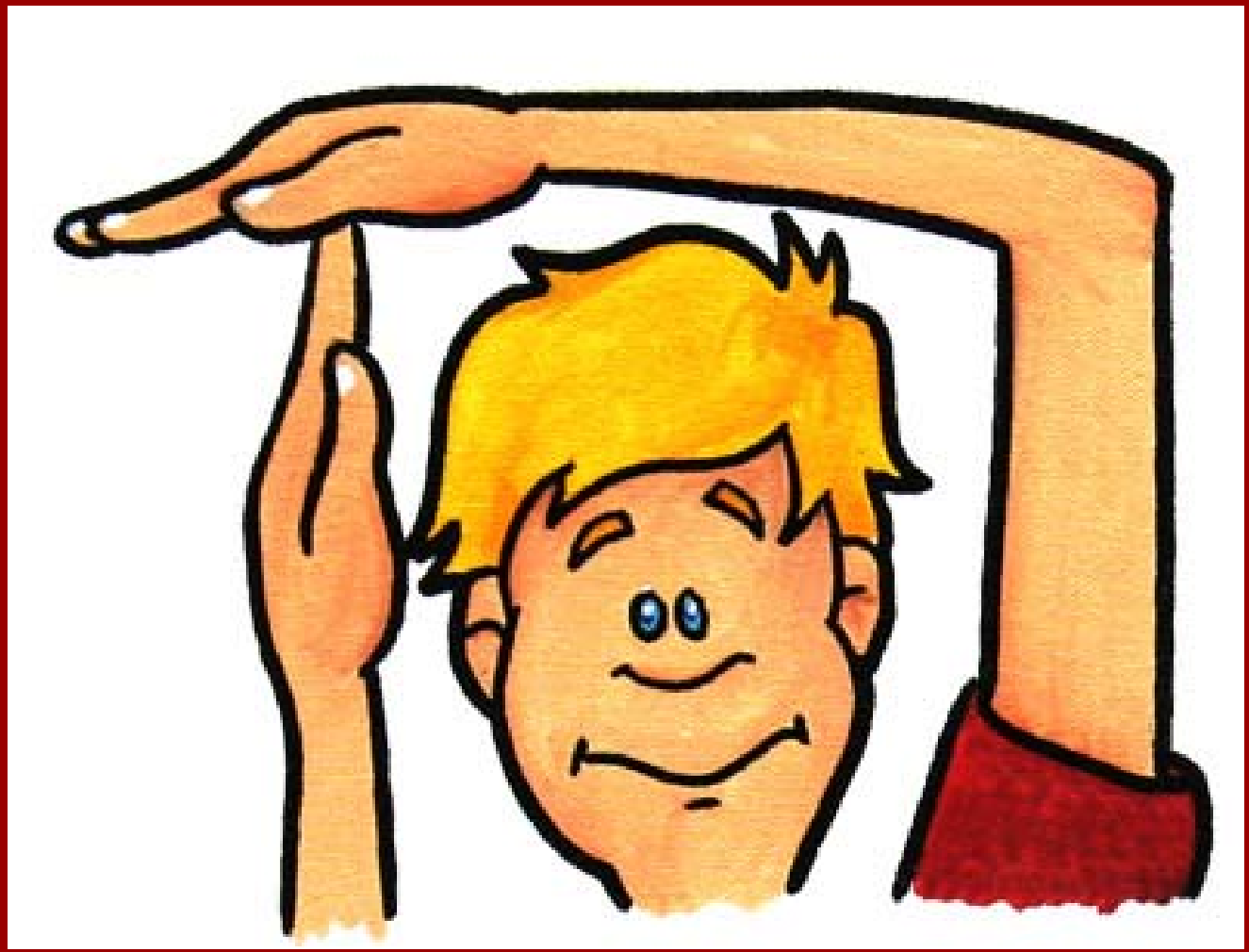

cf:


43
45

Dancing can be super aerobic exercise, too, & you don't have to be a star!

Extremes of the energy continuum!

Time-out for discussion!



Lombo's simplified steps!

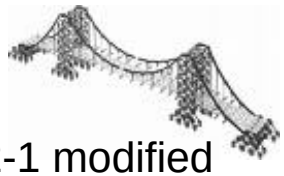
1 **Breathe in & out!**

2 **Cross membranes!**

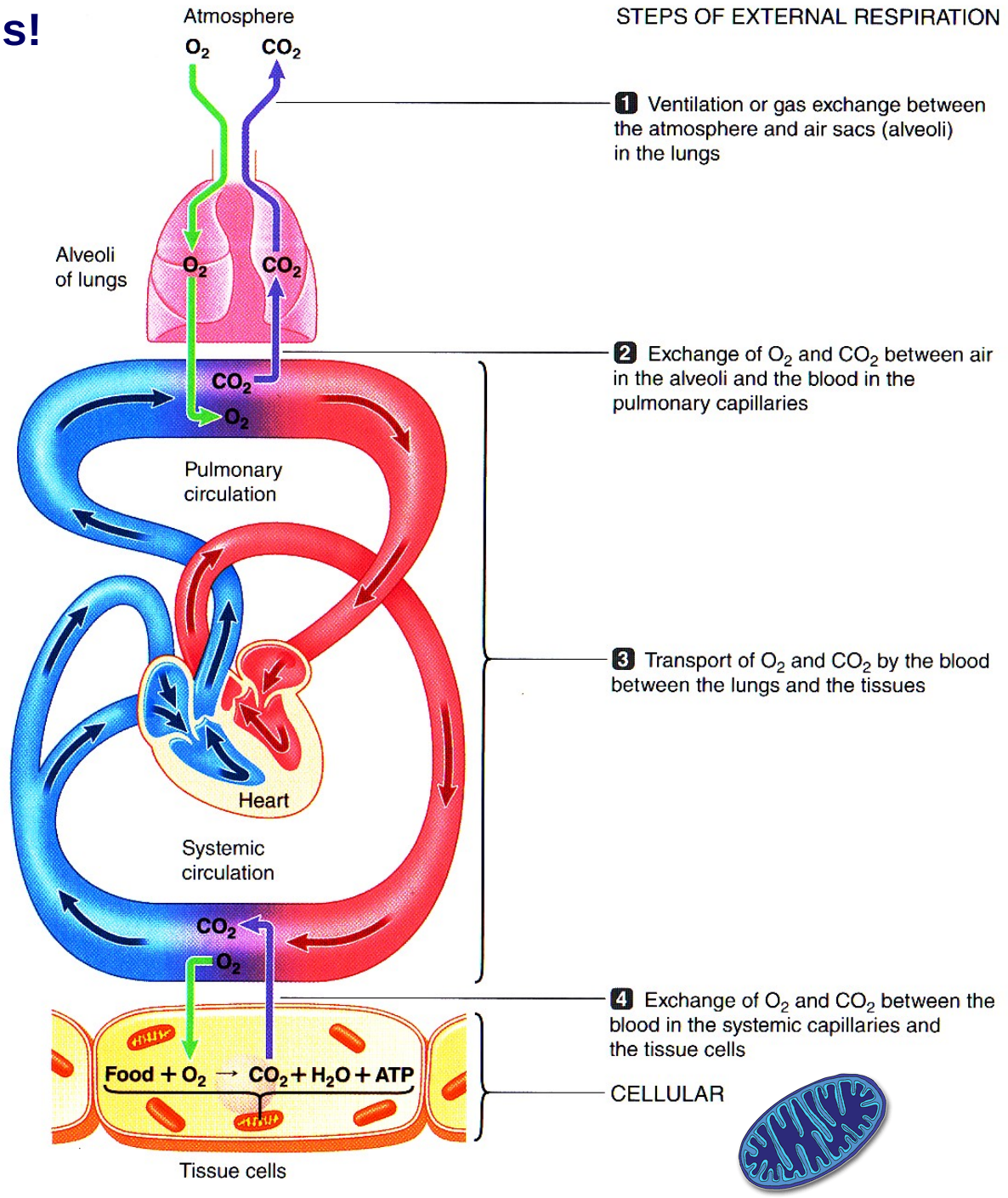
3 **Move with blood!**

Go with the flow!

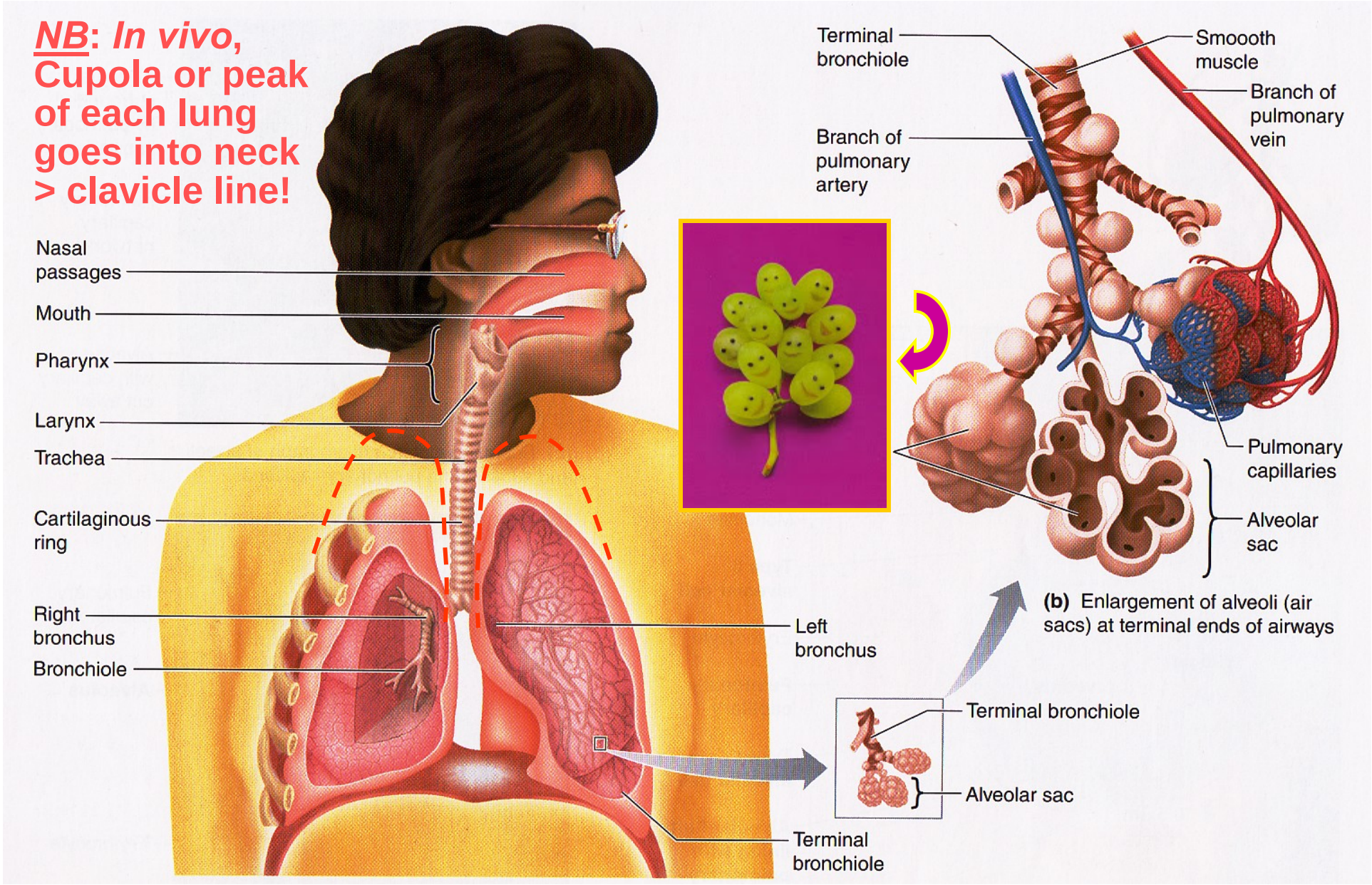
4 **Cross membranes!**



LS 2012 fig 12-1 modified

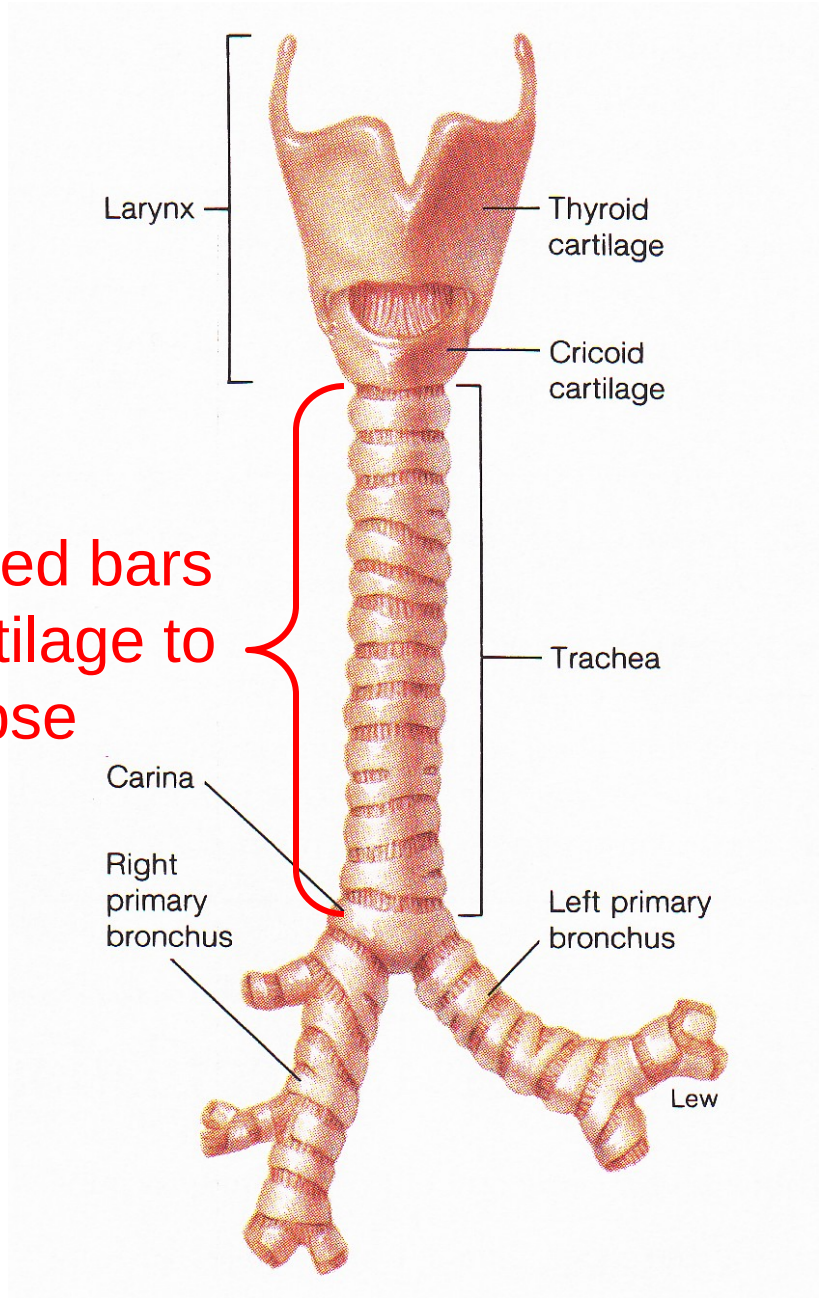


Respiratory System Anatomy

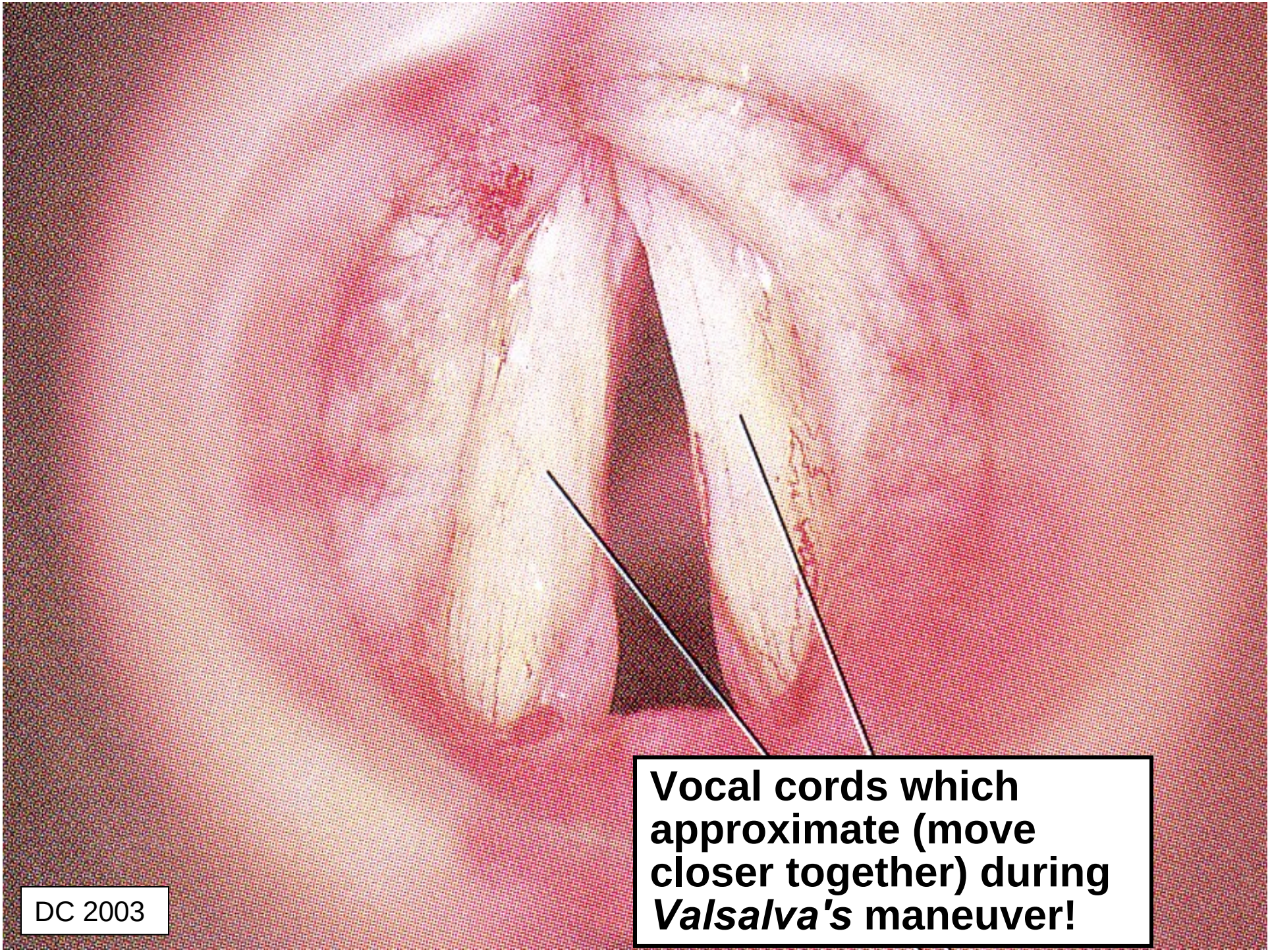


LS 2012 fig 12-2

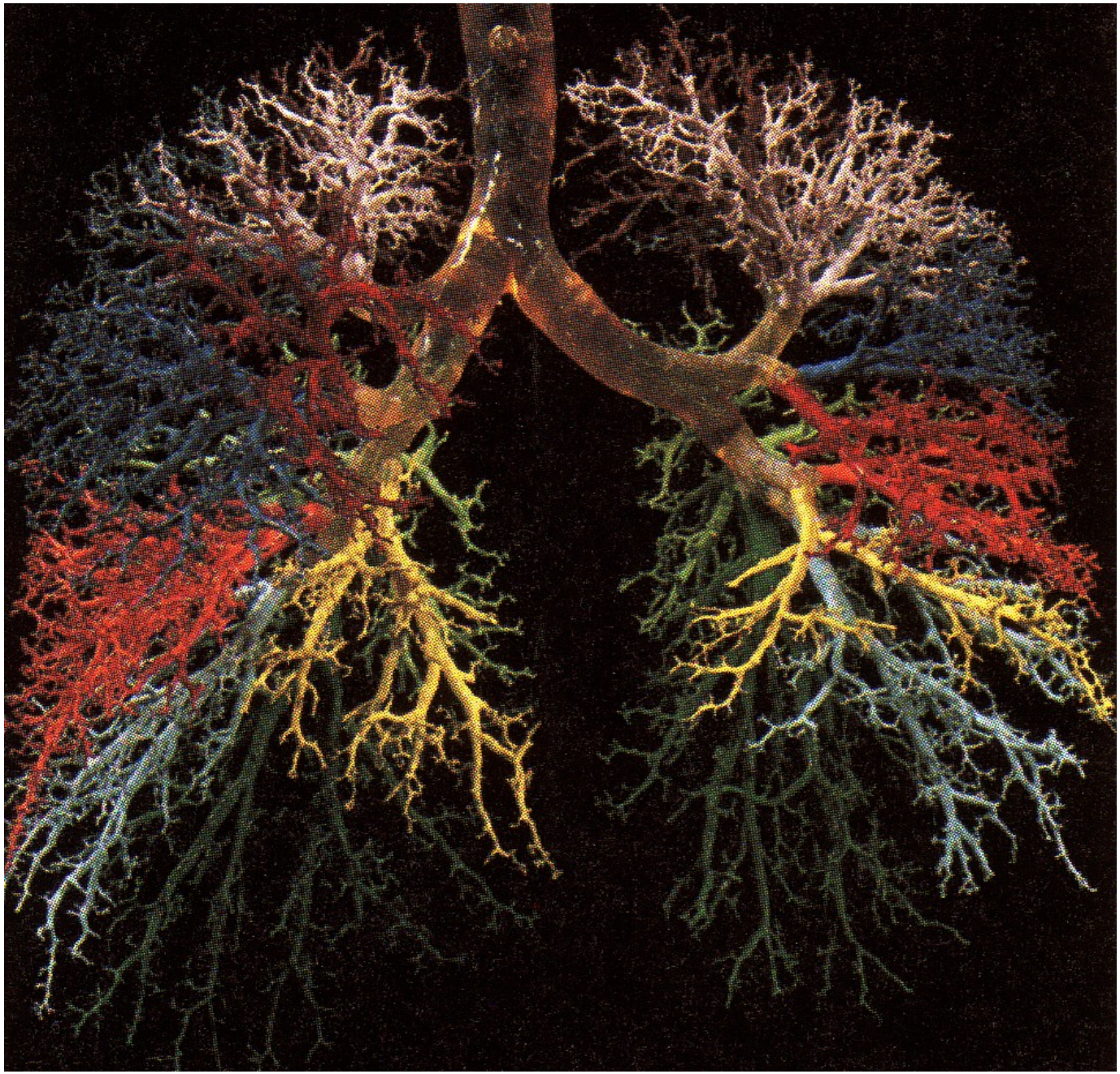
16-20 C-shaped bars of hyaline cartilage to prevent collapse



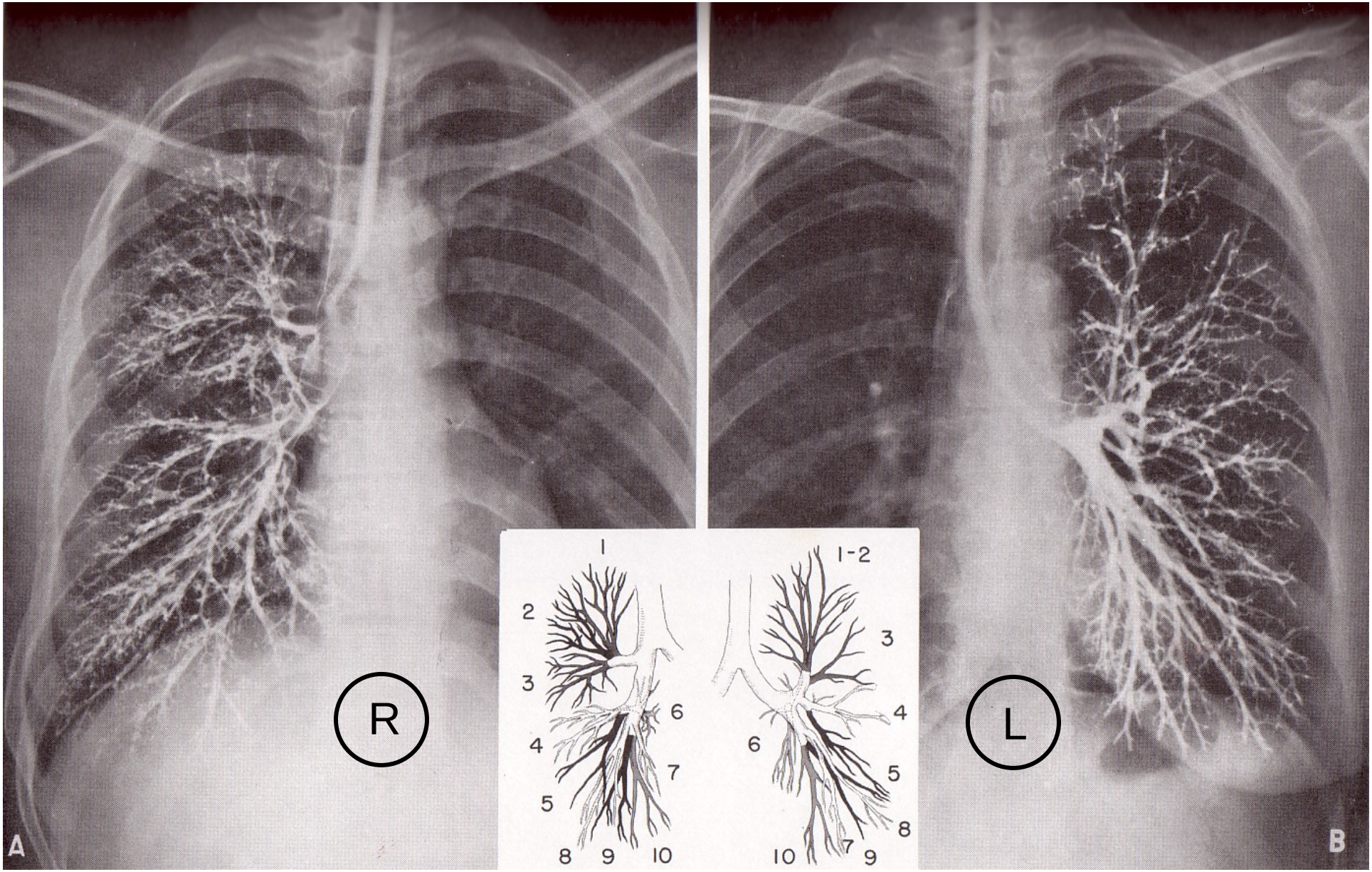
DC 2003


Vocal cords which approximate (move closer together) during *Valsalva's* maneuver!
DC 2003

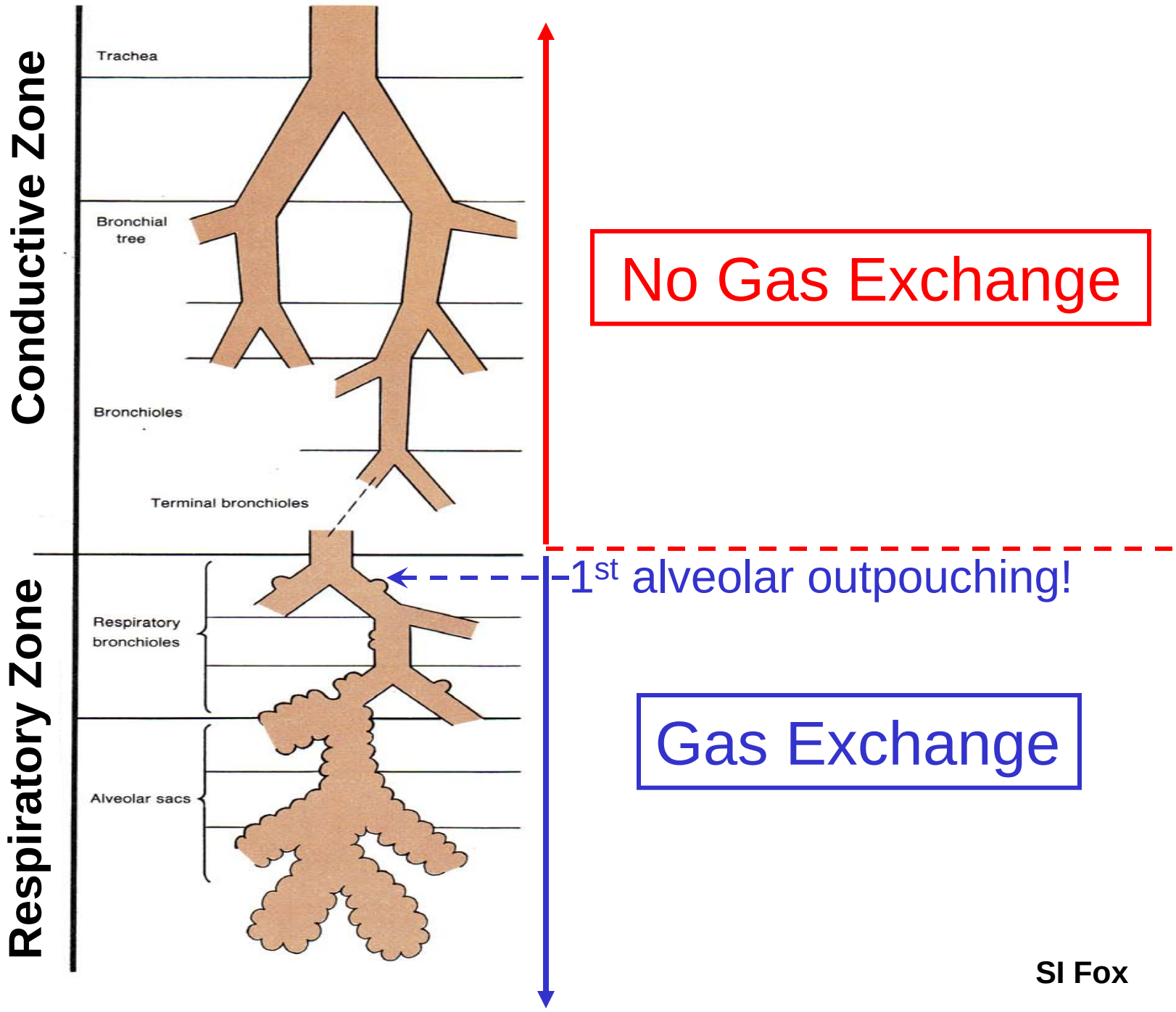
Pulmonary Latex Cast with Colored Segmentation



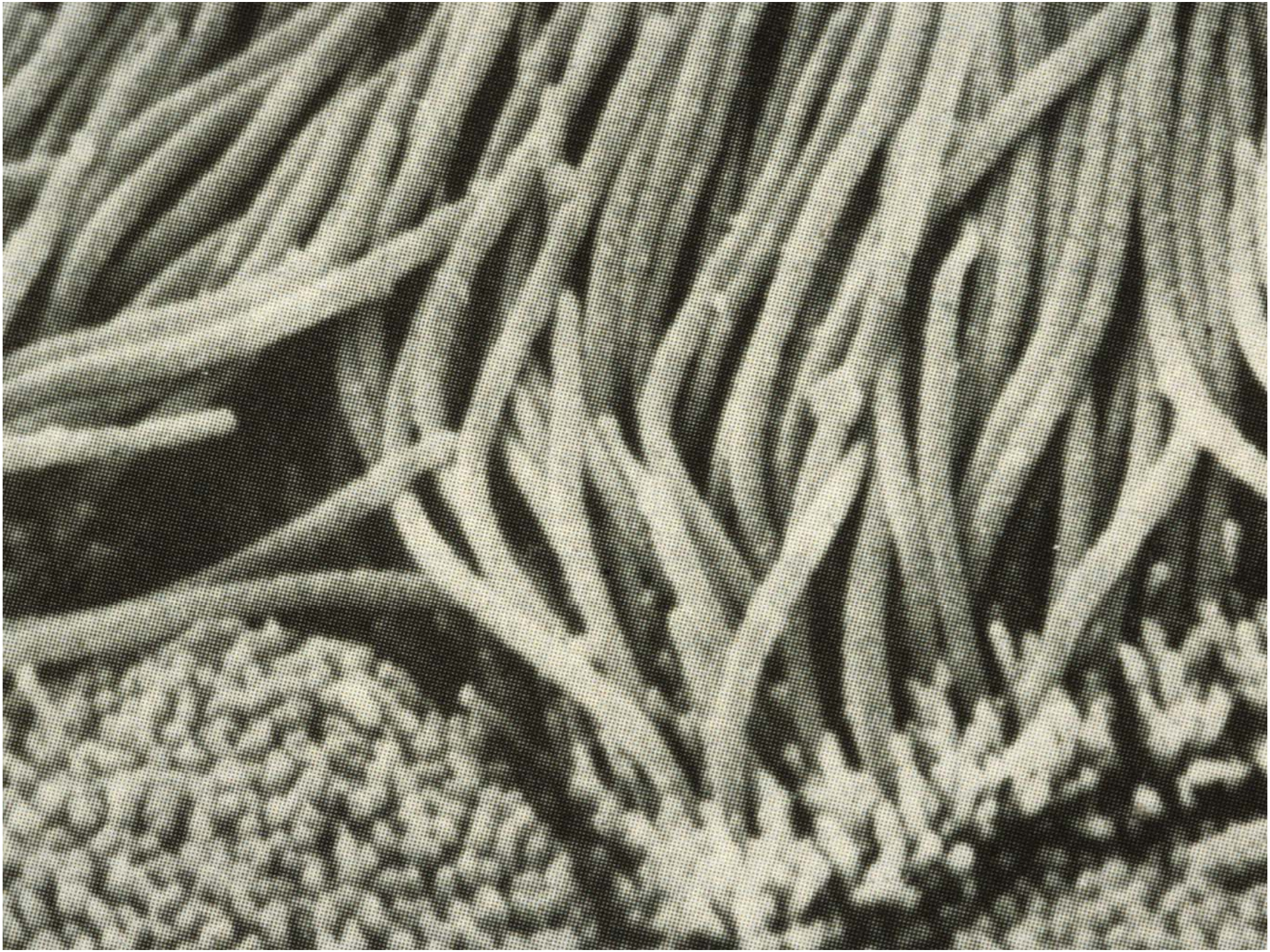
Bronchograms (posteroanterior)

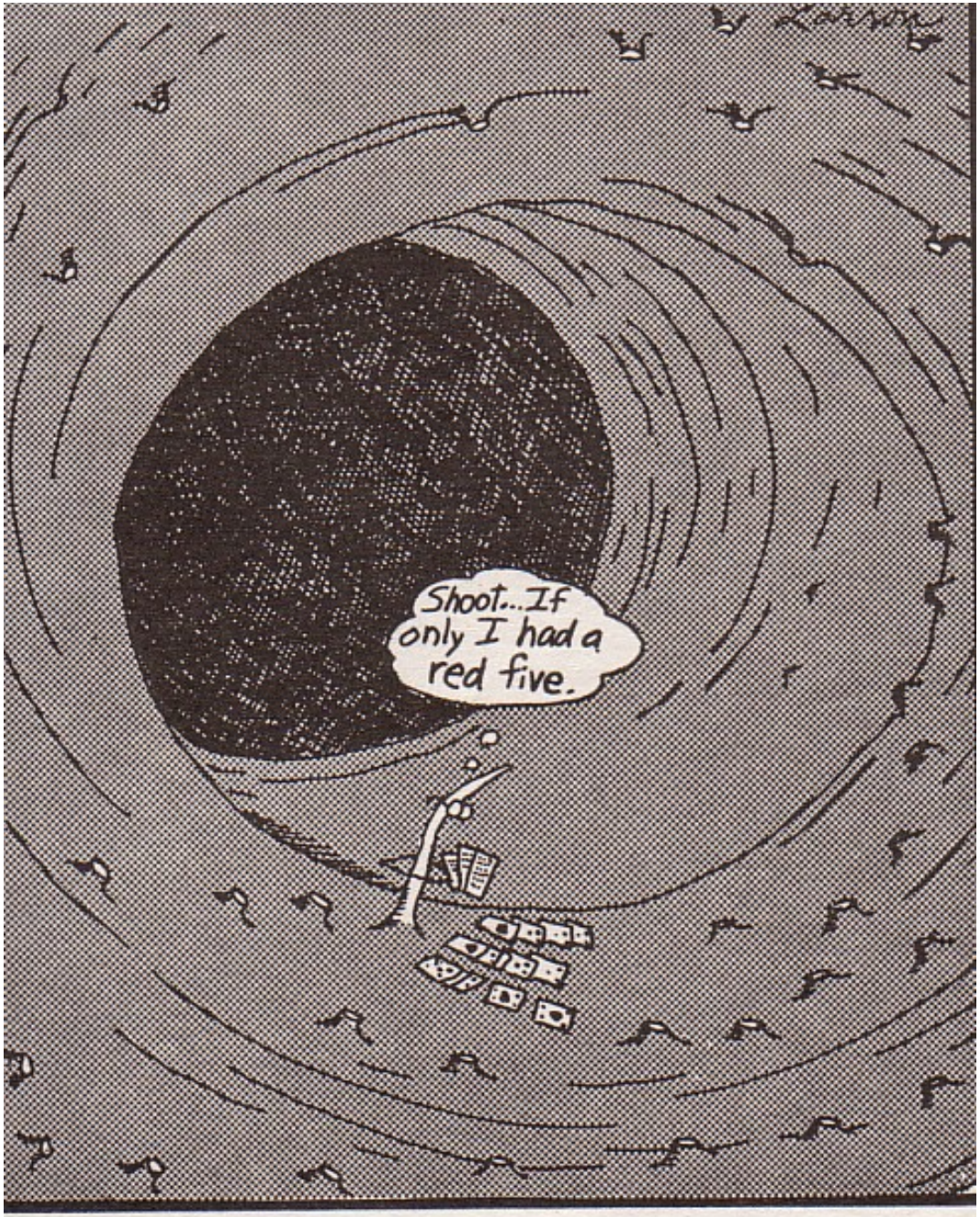


Source: Gardner, Gray, O'Rahilly, *Anatomy*, fig 29-11, p 295.

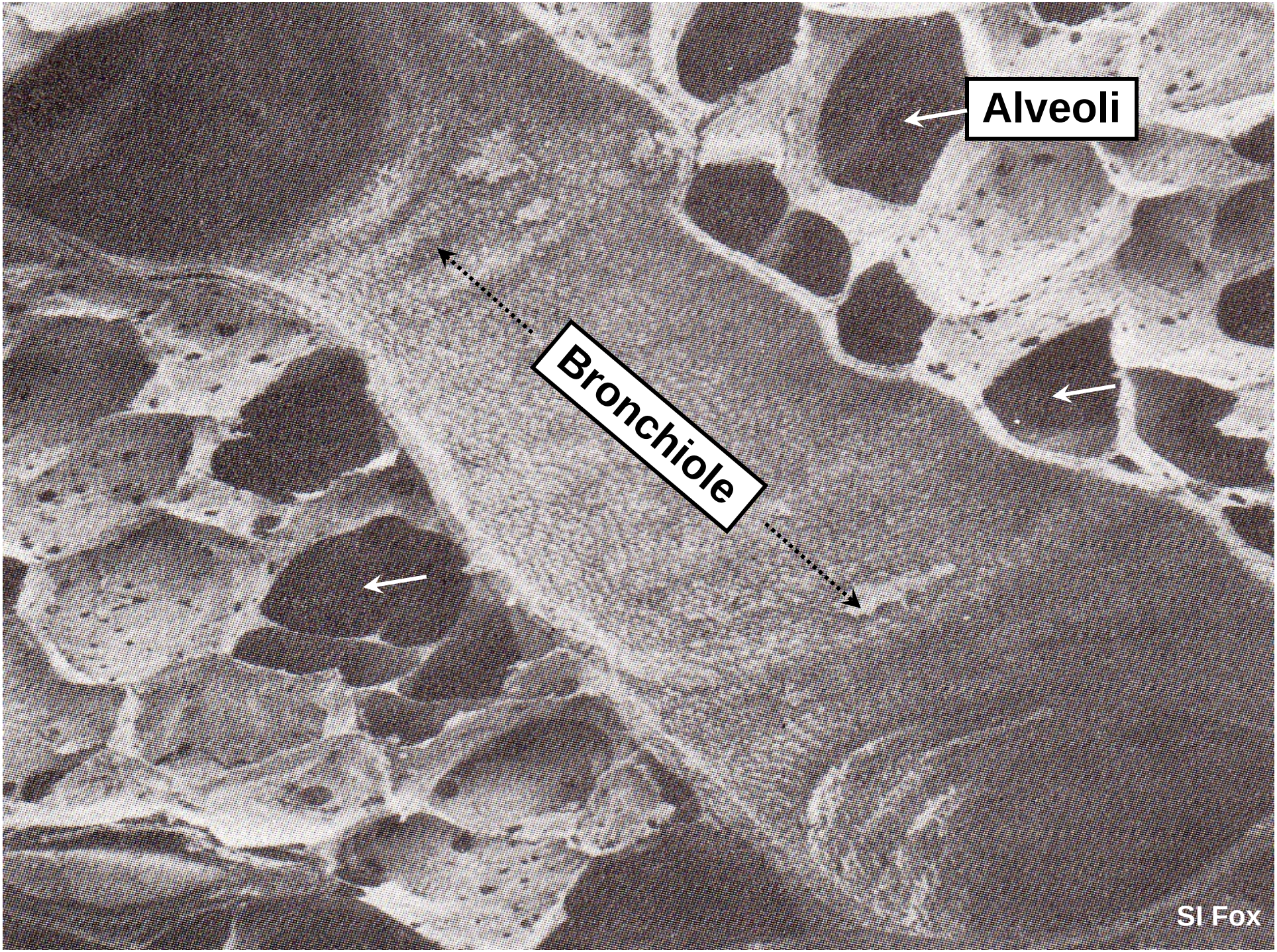

Conductive Zone
Respiratory Zone
Trachea
Bronchial tree
Bronchioles
Terminal bronchioles
Respiratory bronchioles
Alveolar sacs
No Gas Exchange
1st alveolar outpouching!
Gas Exchange

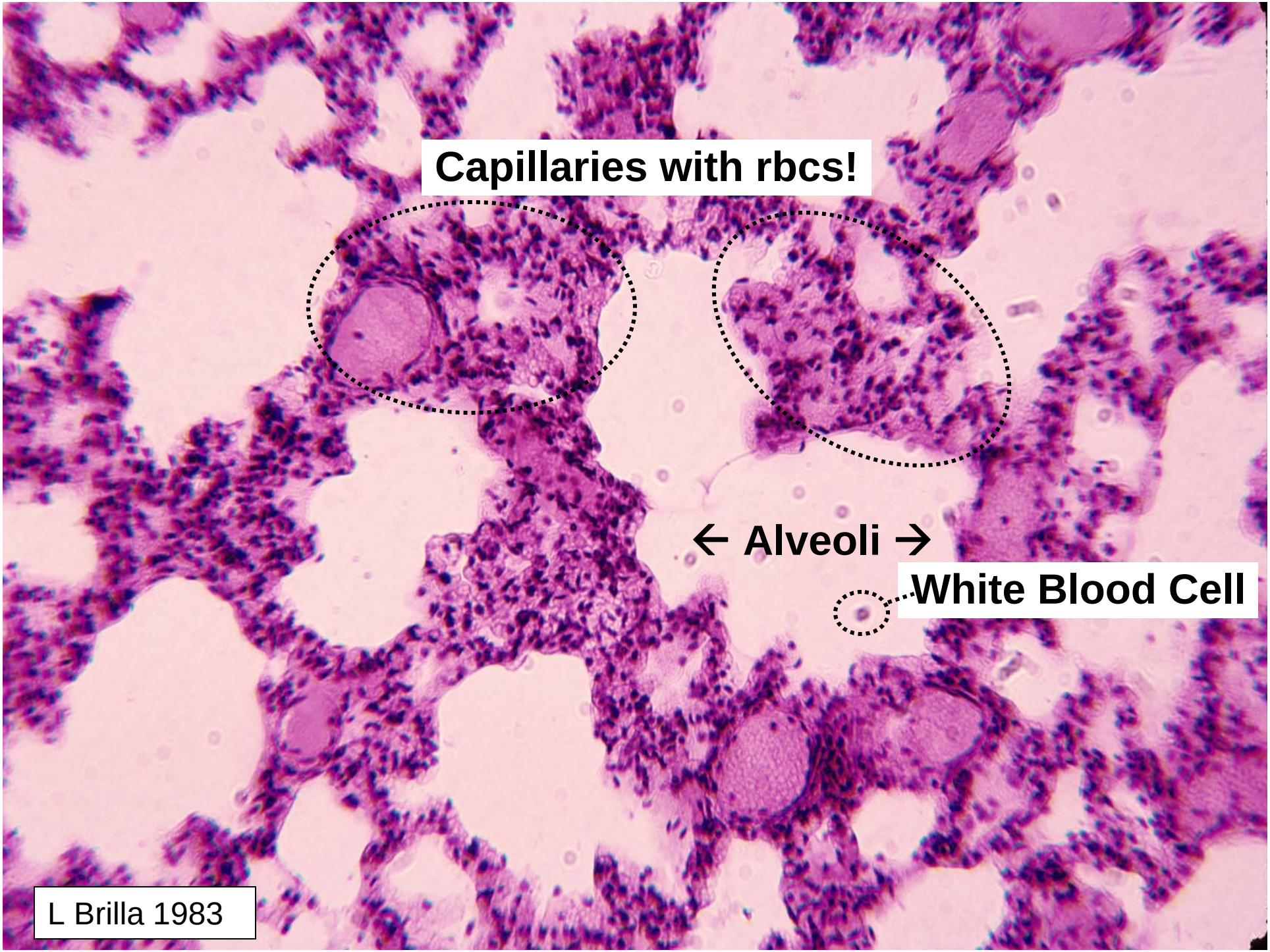
SI Fox





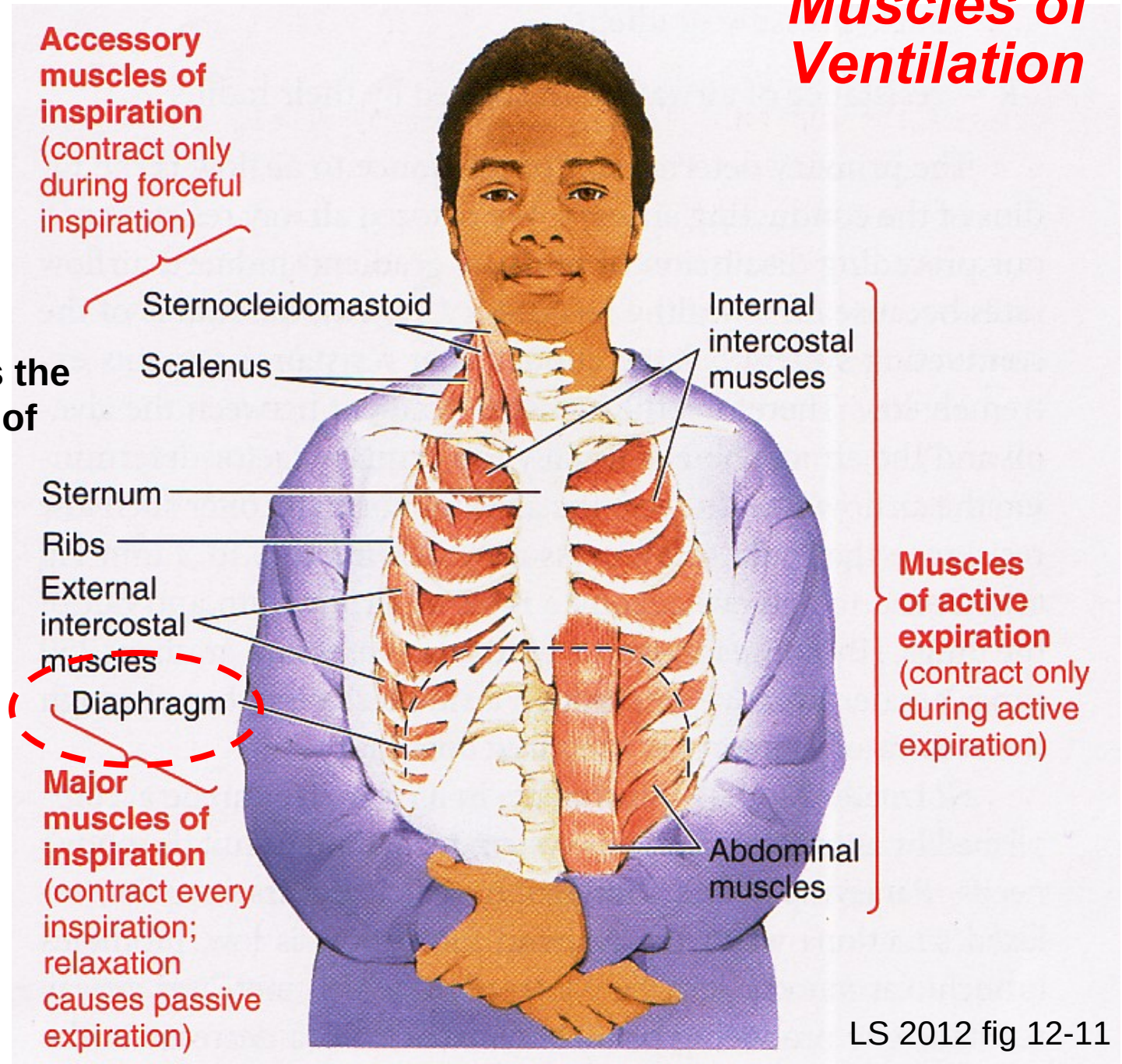
The last cilium on a smoker's lung


Alveoli
Bronchiole
SI Fox

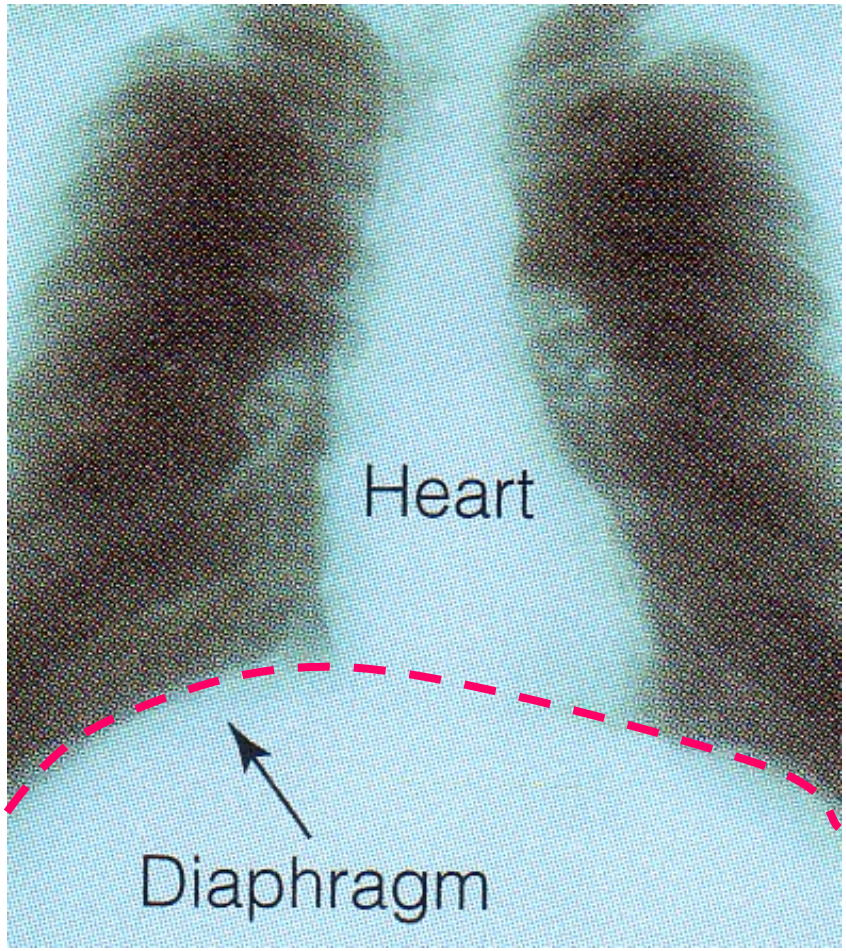

Capillaries with rbcs!
← Alveoli →
White Blood Cell
L Brilla 1983

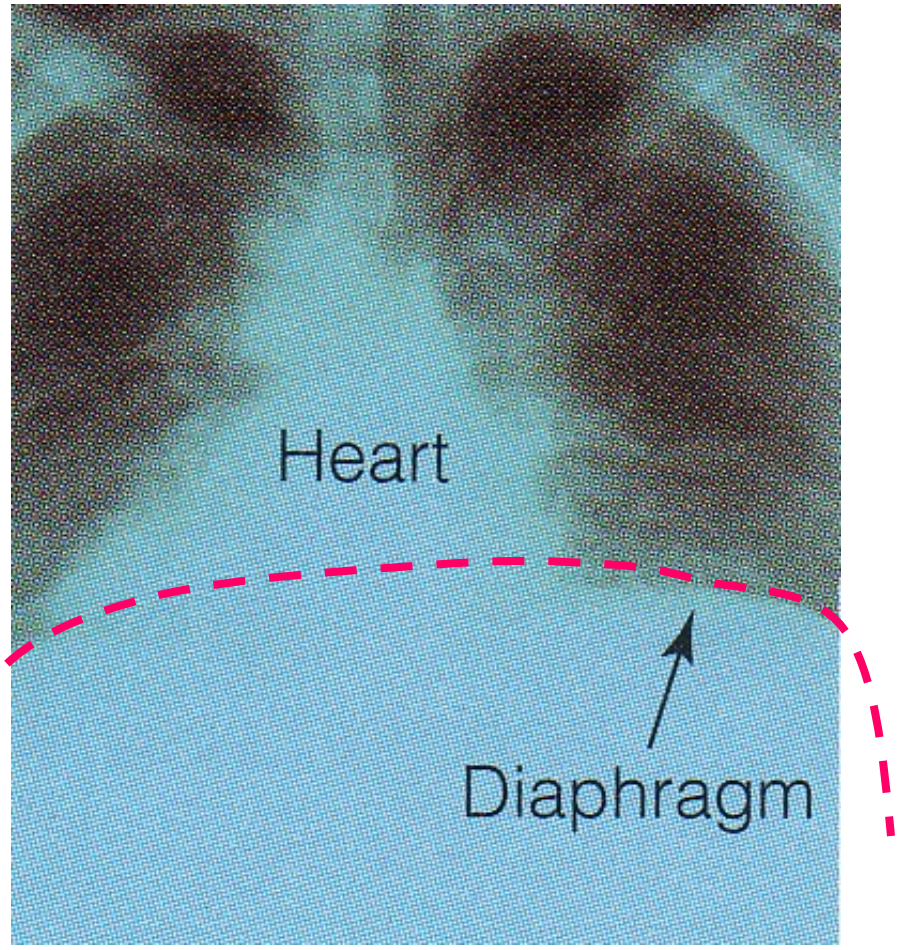
Muscles of Ventilation

NB: Diaphragm is the chief muscle of ventilation!



LS 2012 fig 12-11





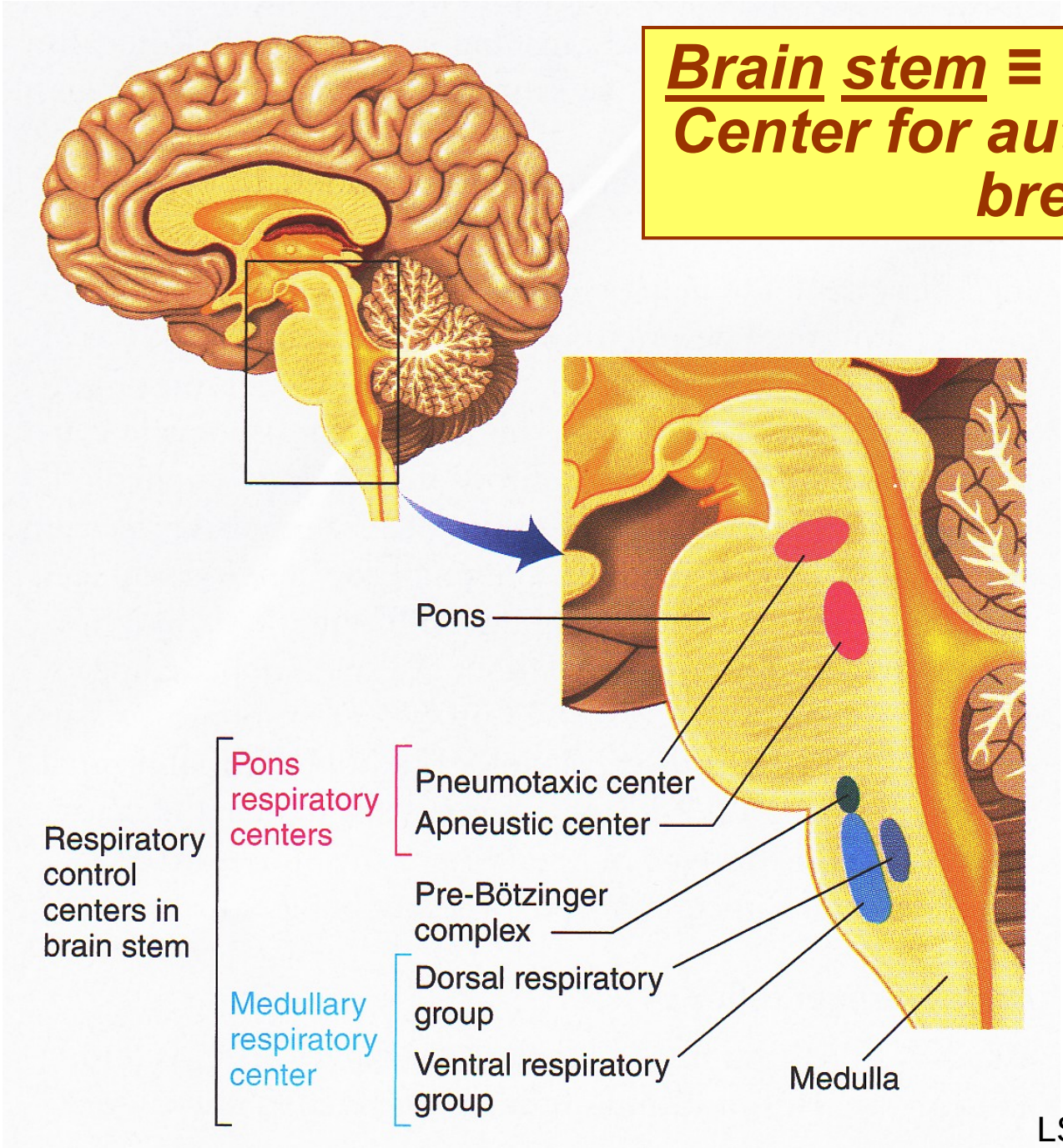
<u>Inhale</u> (active)

<u>Exhale</u> (passive @ rest)

<u>Contract</u> & flatten diaphragm

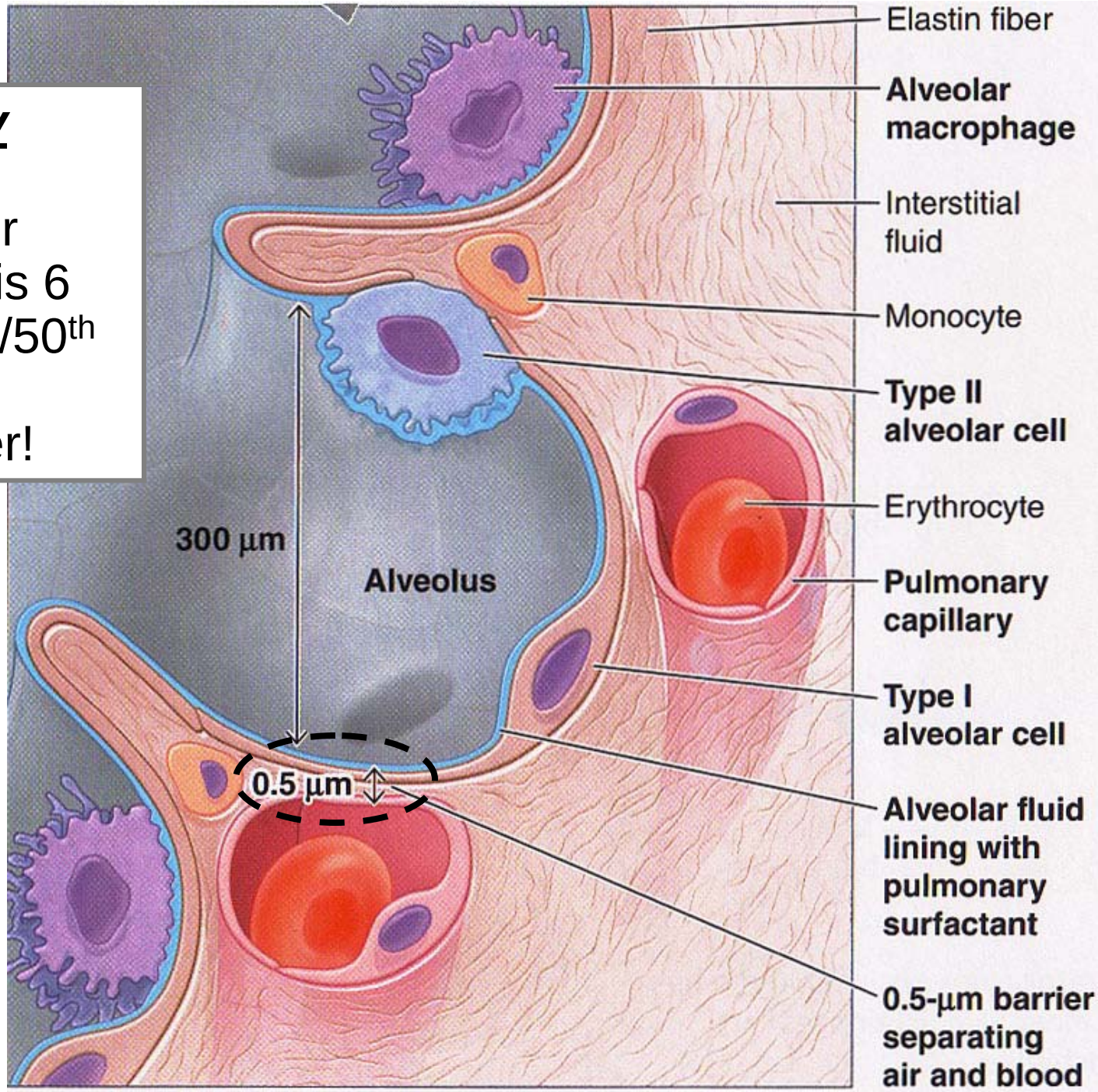
<u>Relax</u> & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!



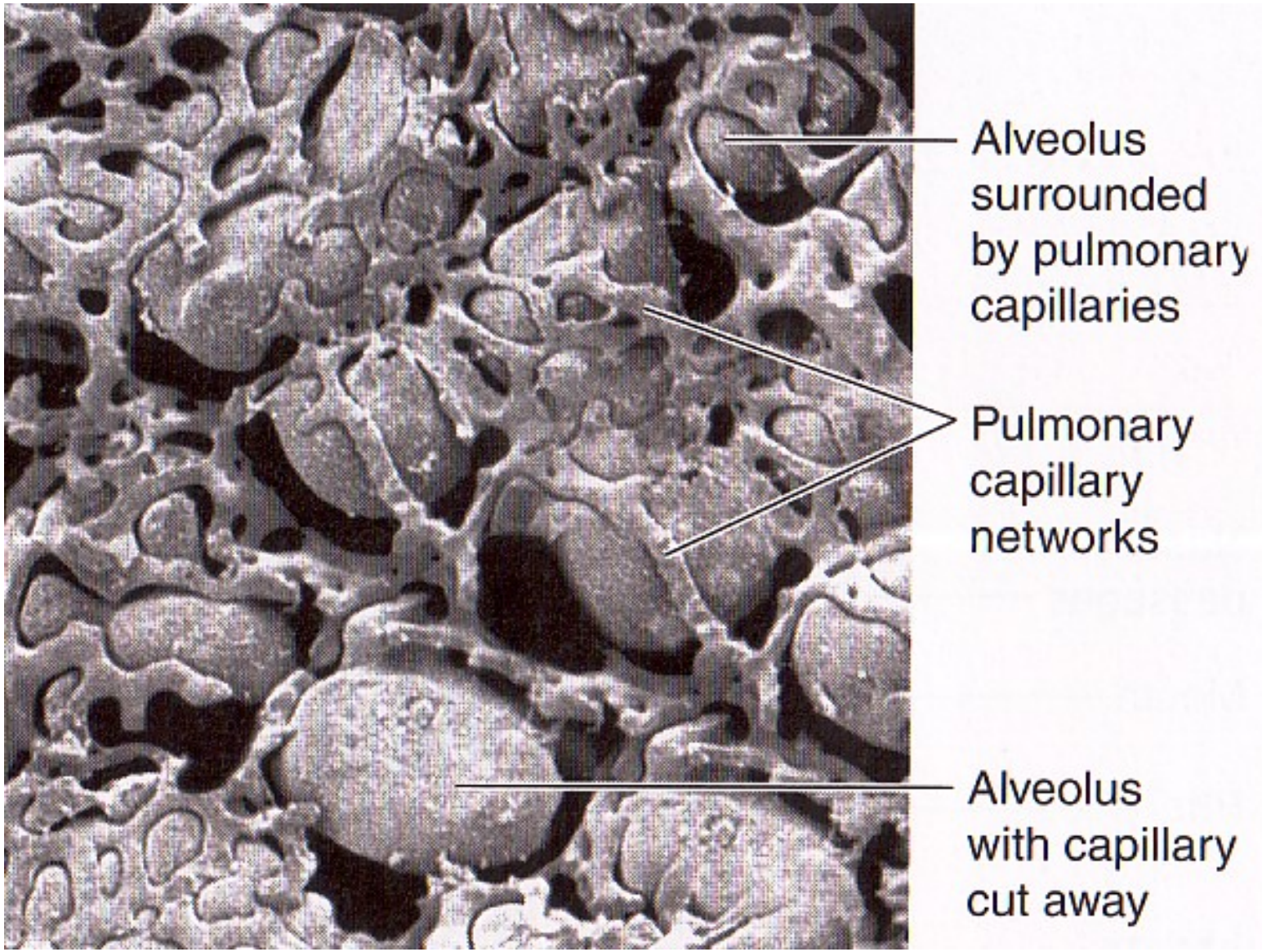
LS 2012 fig 12-25

Respiratory membrane separates air from blood, is 6 layers, yet 1/50th thickness of tracing paper!



LS 2012 fig 12-4a

Alveoli are surrounded by jackets of capillaries!

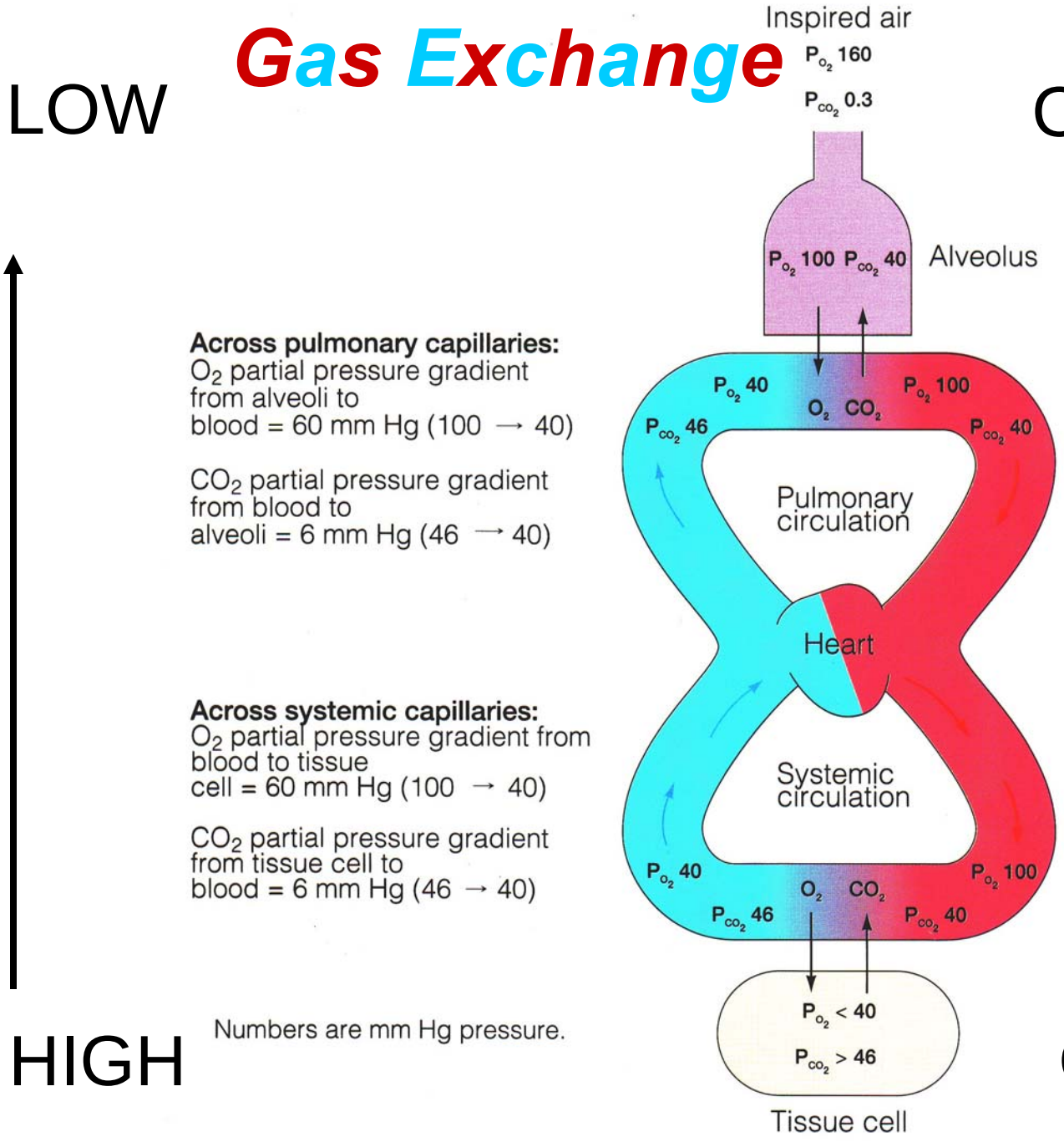


LS 2012 fig 12-4b

Gas Exchange

CO_2 LOW

O_2 HIGH



Across pulmonary capillaries:
O_2 partial pressure gradient from alveoli to blood = 60 mm Hg (100 → 40)

CO_2 partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

Across systemic capillaries:
O_2 partial pressure gradient from blood to tissue cell = 60 mm Hg (100 → 40)

CO_2 partial pressure gradient from tissue cell to blood = 6 mm Hg (46 → 40)

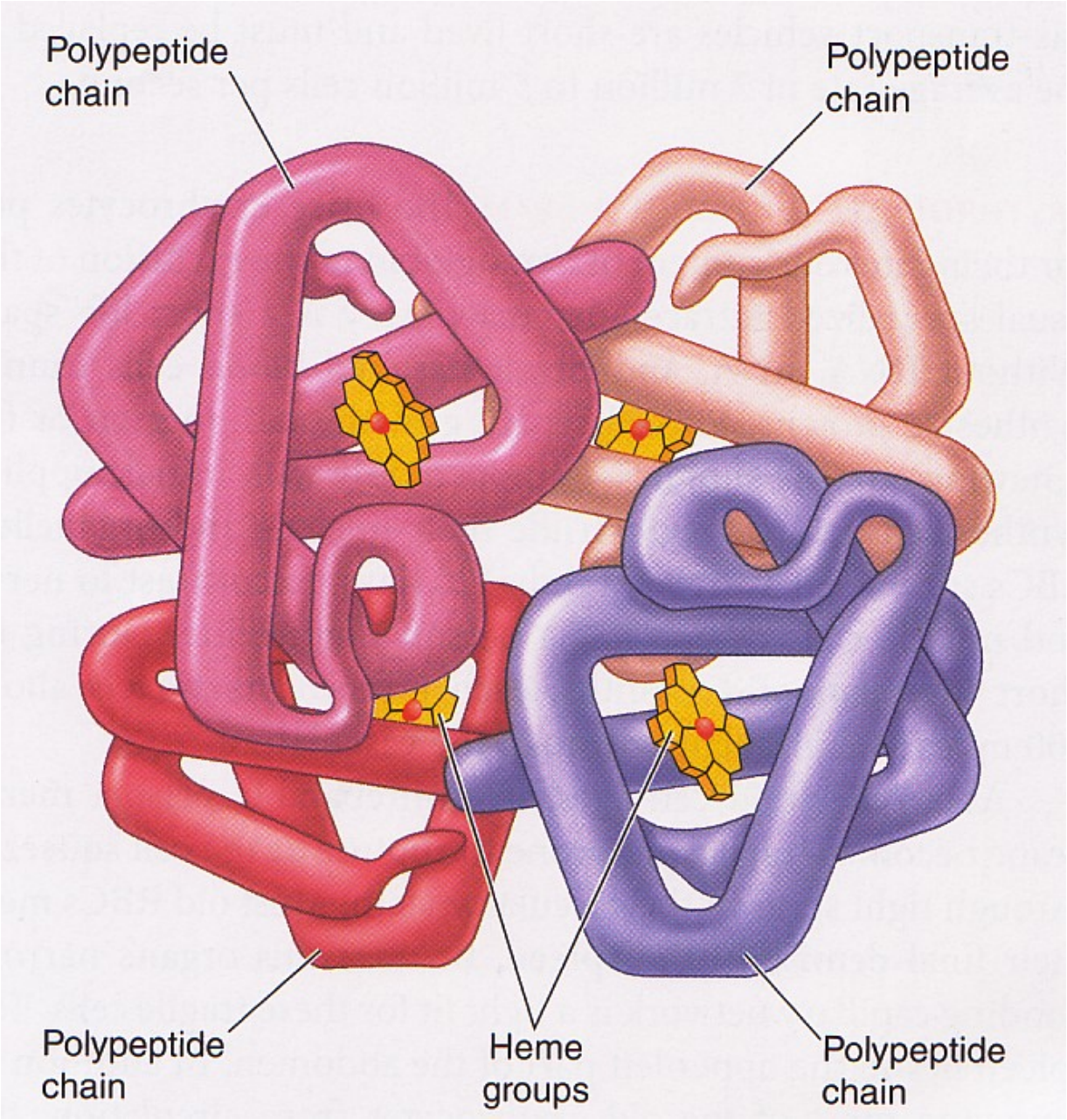
Numbers are mm Hg pressure.

CO_2 HIGH

O_2 LOW

cf: LS 2012 fig 12-19

O_2 is carried mainly by red blood cell hemoglobin!



LS 2012 fig 11-2

TABLE 12-3

Methods of Gas Transport in the Blood

GAS	METHOD OF TRANSPORT IN BLOOD	PERCENTAGE CARRIED IN THIS FORM
O_2	Physically dissolved	1.5
	Bound to hemoglobin	98.5
CO_2	Physically dissolved	10
	Bound to hemoglobin	30
	As bicarbonate (HCO_3^-)	60

LS 2006, cf: LS 2012 tab 12-3

American Cancer Society Great American Smoke Out!

http://www.cancer.org/healthy/stayawayfromtobacco/greatamericansmokeout/

Be safe in travel! Peace!
Have a Happy Turkey Day!!!