
# BI 121 Lecture 16

*I.* ***Announcements*** **Notebooks? Exam II, Dec 13th Friday 8 am. Review session in class next Thurs. Q?**

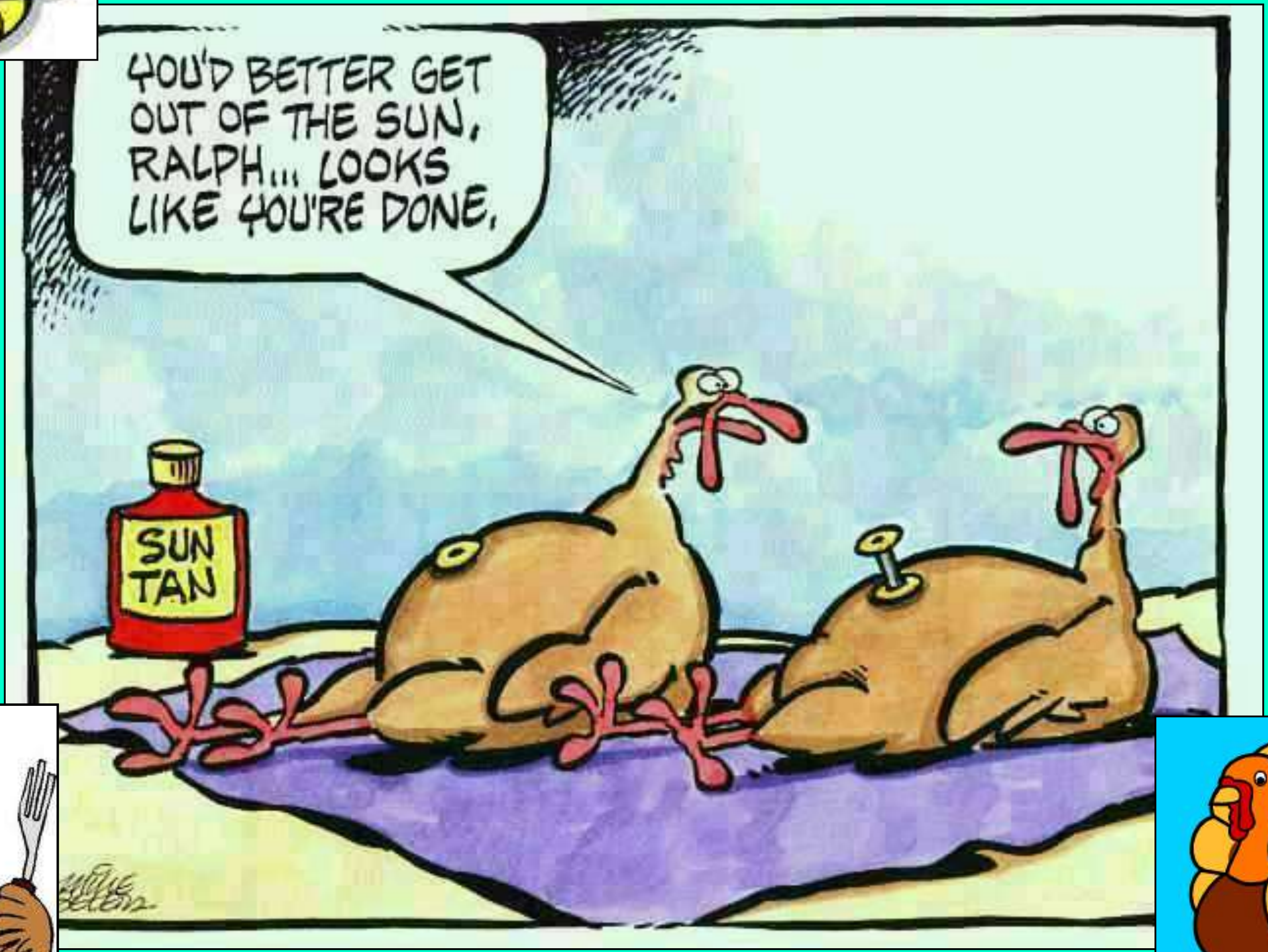
*II.* ***Muscle Contraction & Adaptation*** **LS ch 8, DC Mod 12**

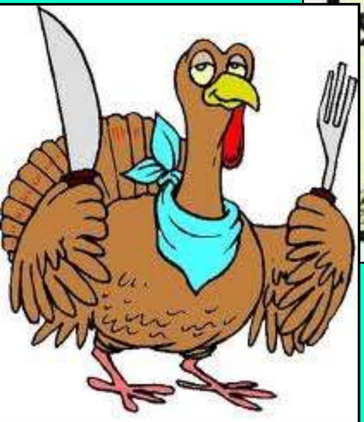
- **A. Summary of skeletal muscle contraction Malcolm Campbell & David Bolinsky videos**
- **B. Exercise adaptation variables: *mode*, *intensity*, *duration*, *frequency*, *distribution*, *individual* & environmental char...?**
- **C. Endurance *vs.* strength training continuum? fiber types...**

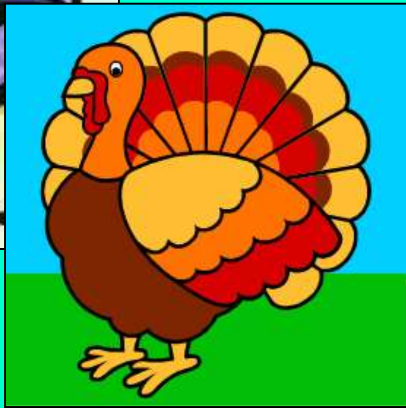
*III.* ***Respiratory System*** **LS ch 12, DC Module 7, Fox +...**

- **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**

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

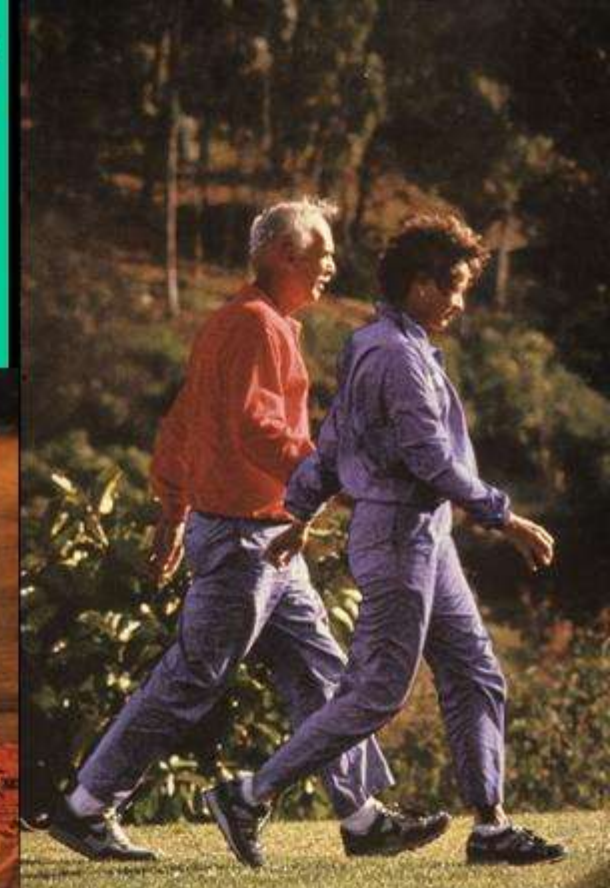




# *Adaptations to Exercise?*

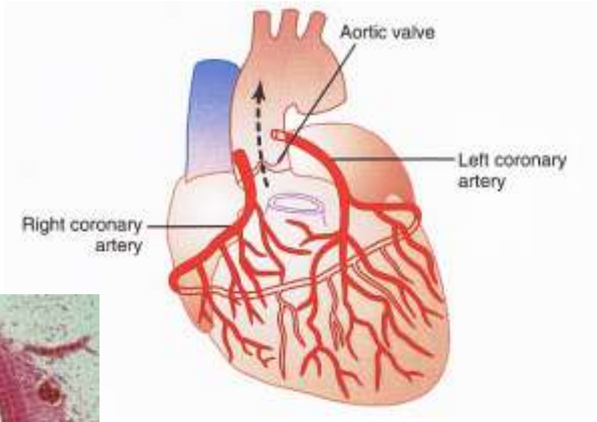
Mode, Intensity, Duration, Frequency,
Distribution of Training Sessions?
Conditions of Environment? Individual?



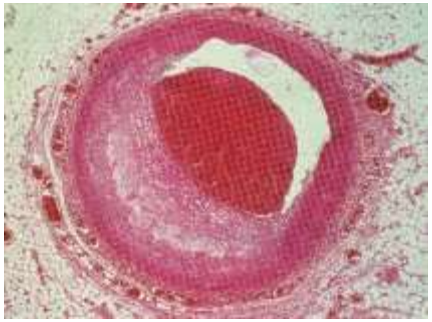
# *Adaptations to Exercise?*

## Body Levels of Organization?
## Which Body System?

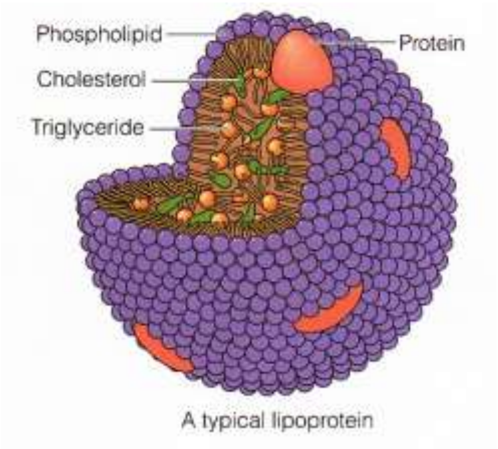
**Body System**




**Organ**

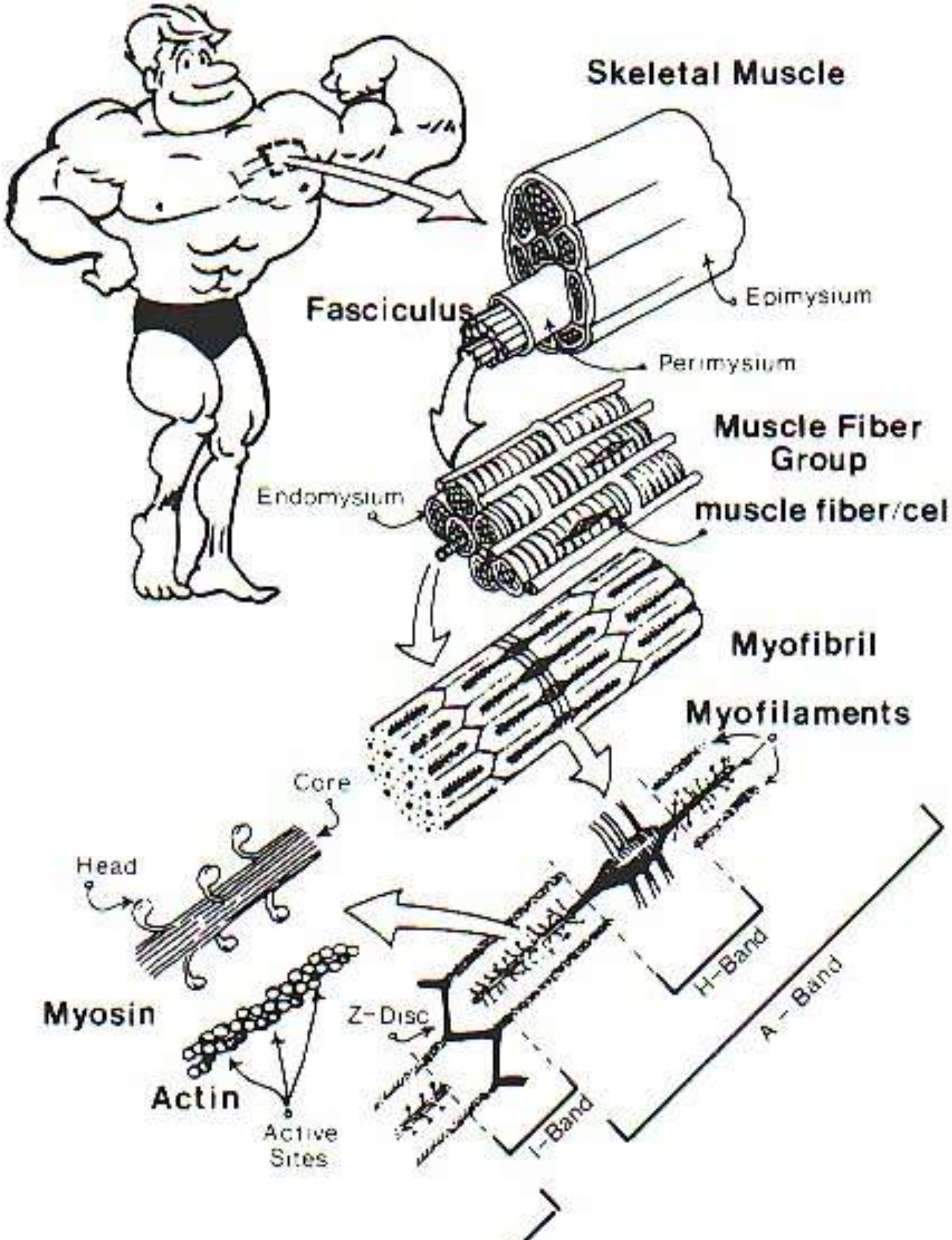


**Cell/Tissue**

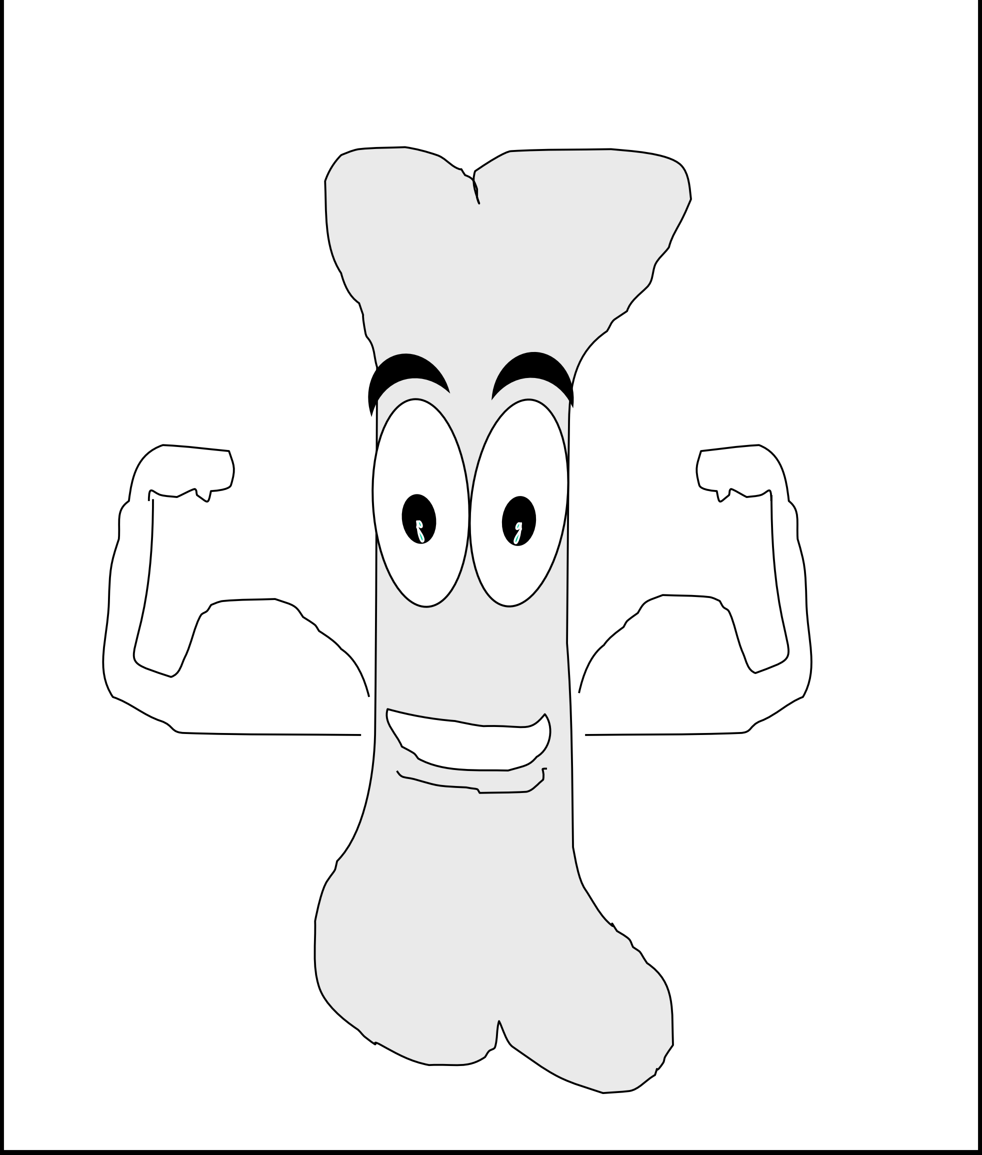



**Molecular**

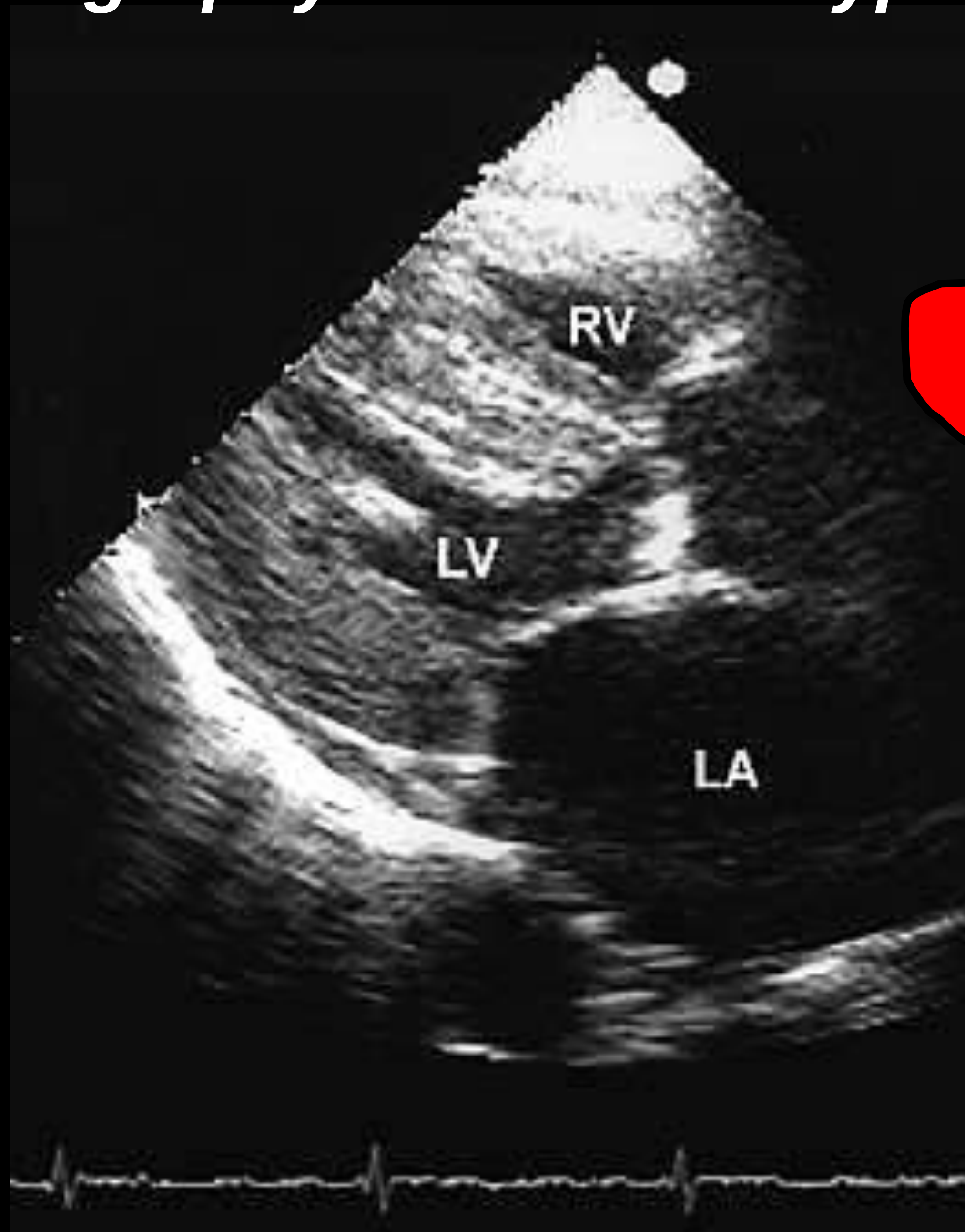
# *Muscle Adaptations to Exercise*



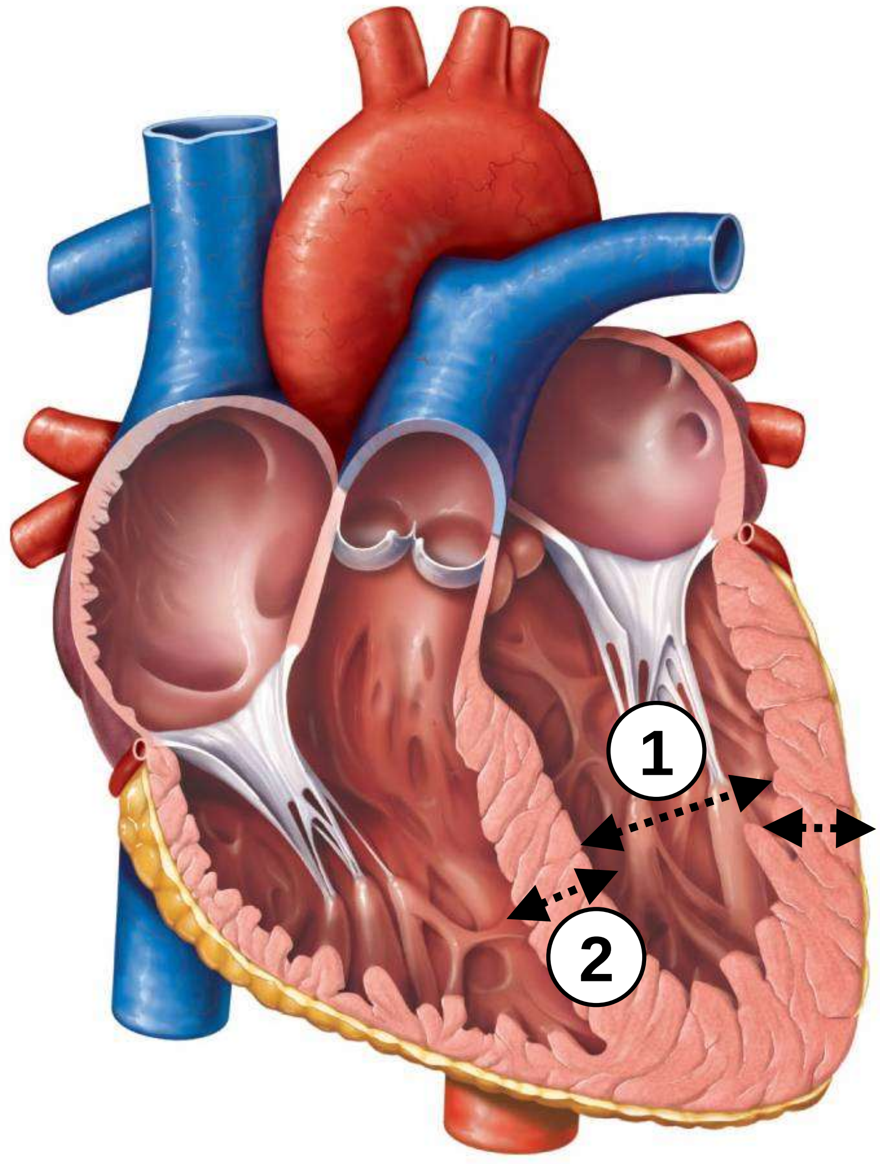
**As muscles tug on bones, bones get stronger, too!...many systems adapt!!**



# *Echocardiography documents hypertrophy...*




# *Cardiac Adaptations to Exercise:*
# ① *Endurance vs.* ② *StrengthTraining*




***NB***: ① > ↑ LBM

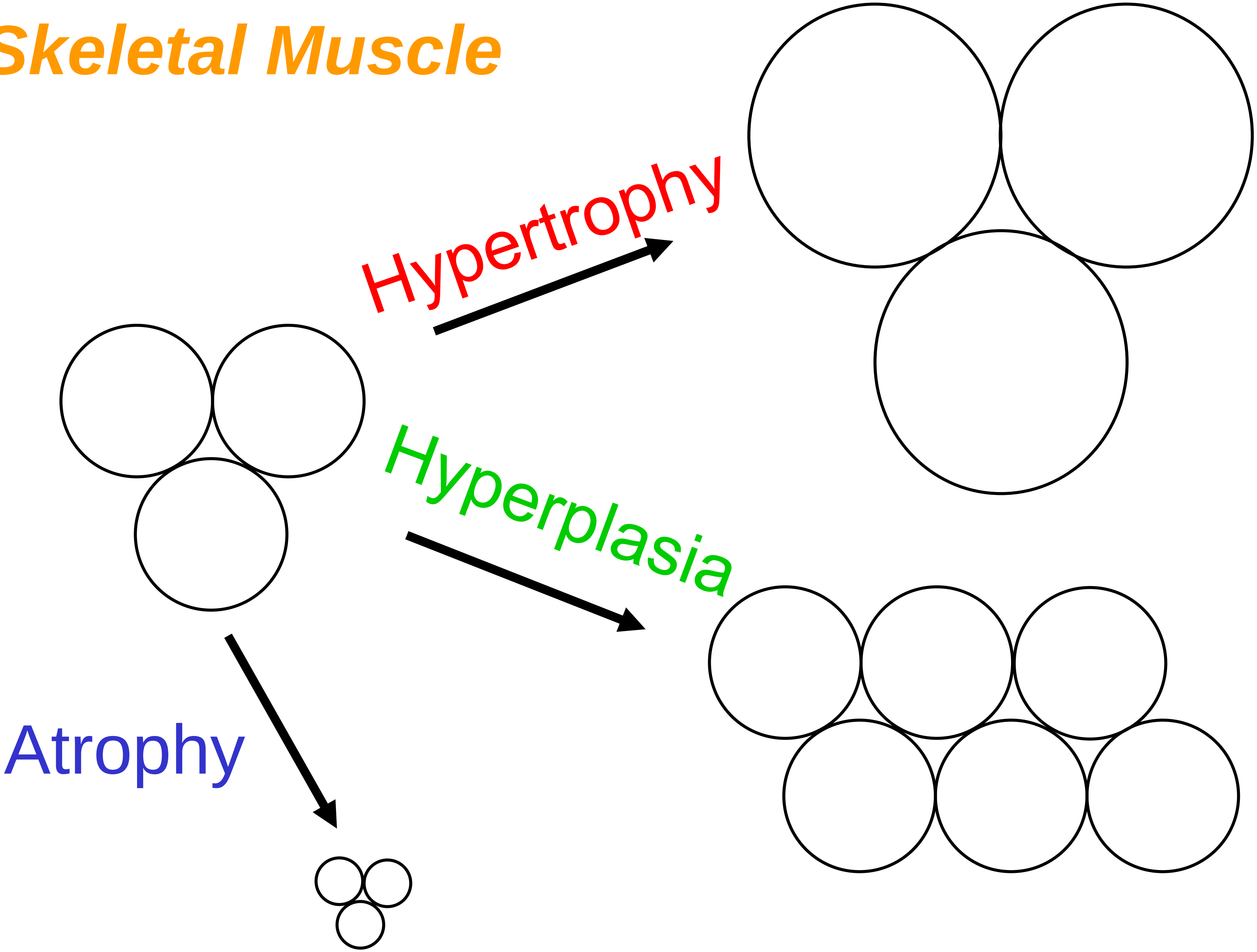

Atrophy

*decrease in size & strength*

Hypertrophy

*increase in size & strength*

# *Skeletal Muscle*



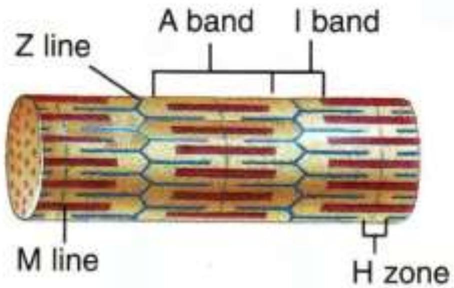
# *Women & Hypertrophy?*

## *What happens in muscles at cellular & subcellular levels?*

Myofibril

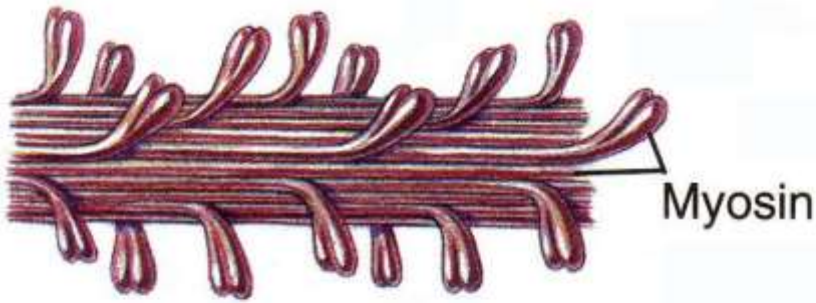
# Hypertrophy: *Increased*

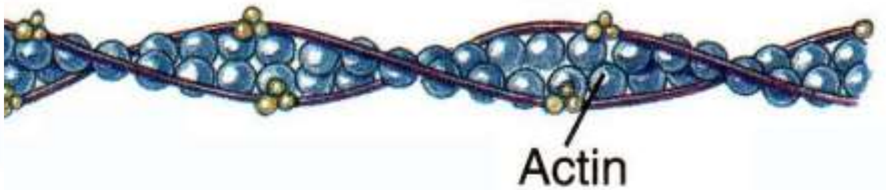
# *Number of Myofibrils*

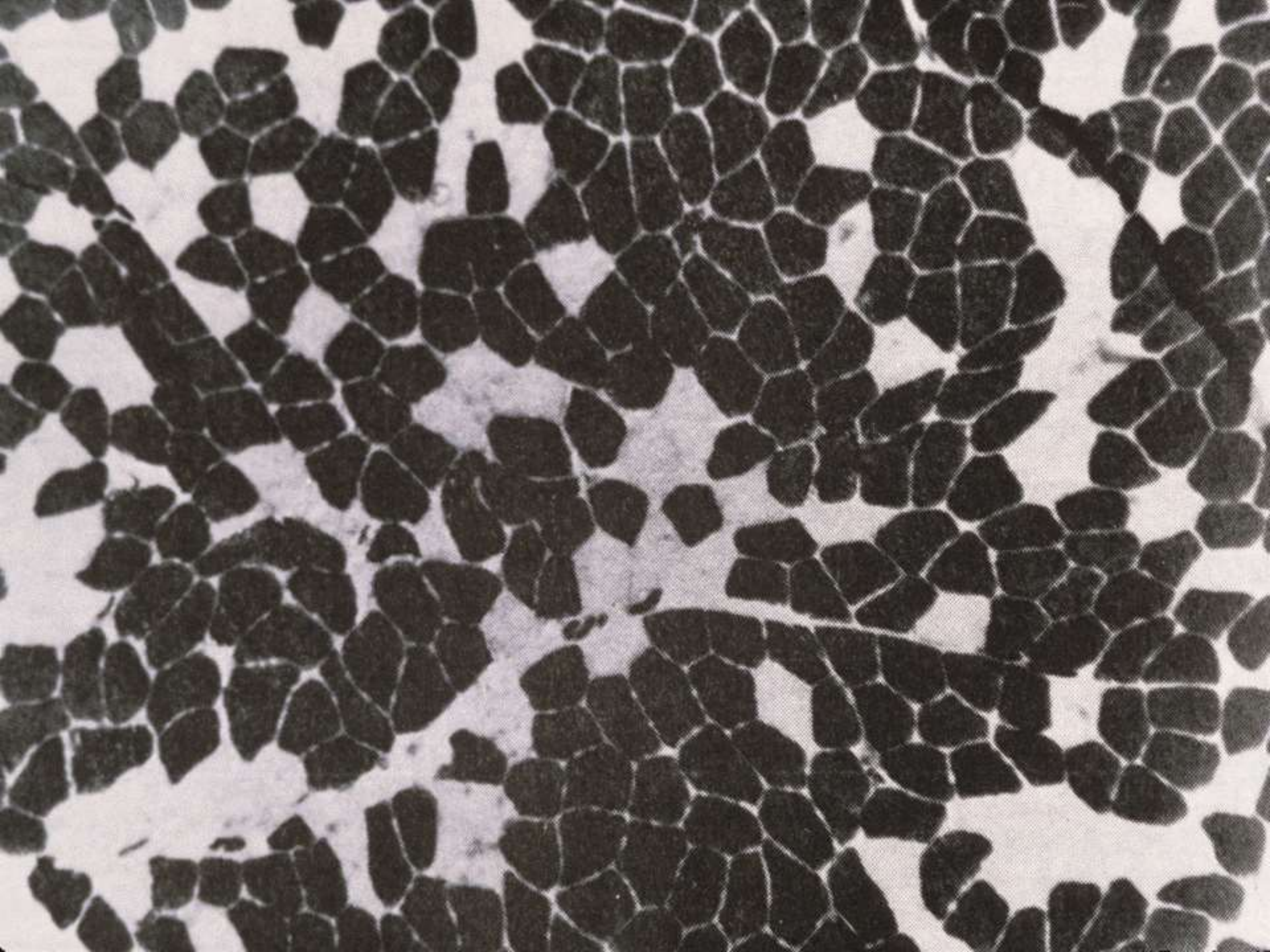



# *Thick & Thin Filaments*

# *Myosin & Actin Molecules*



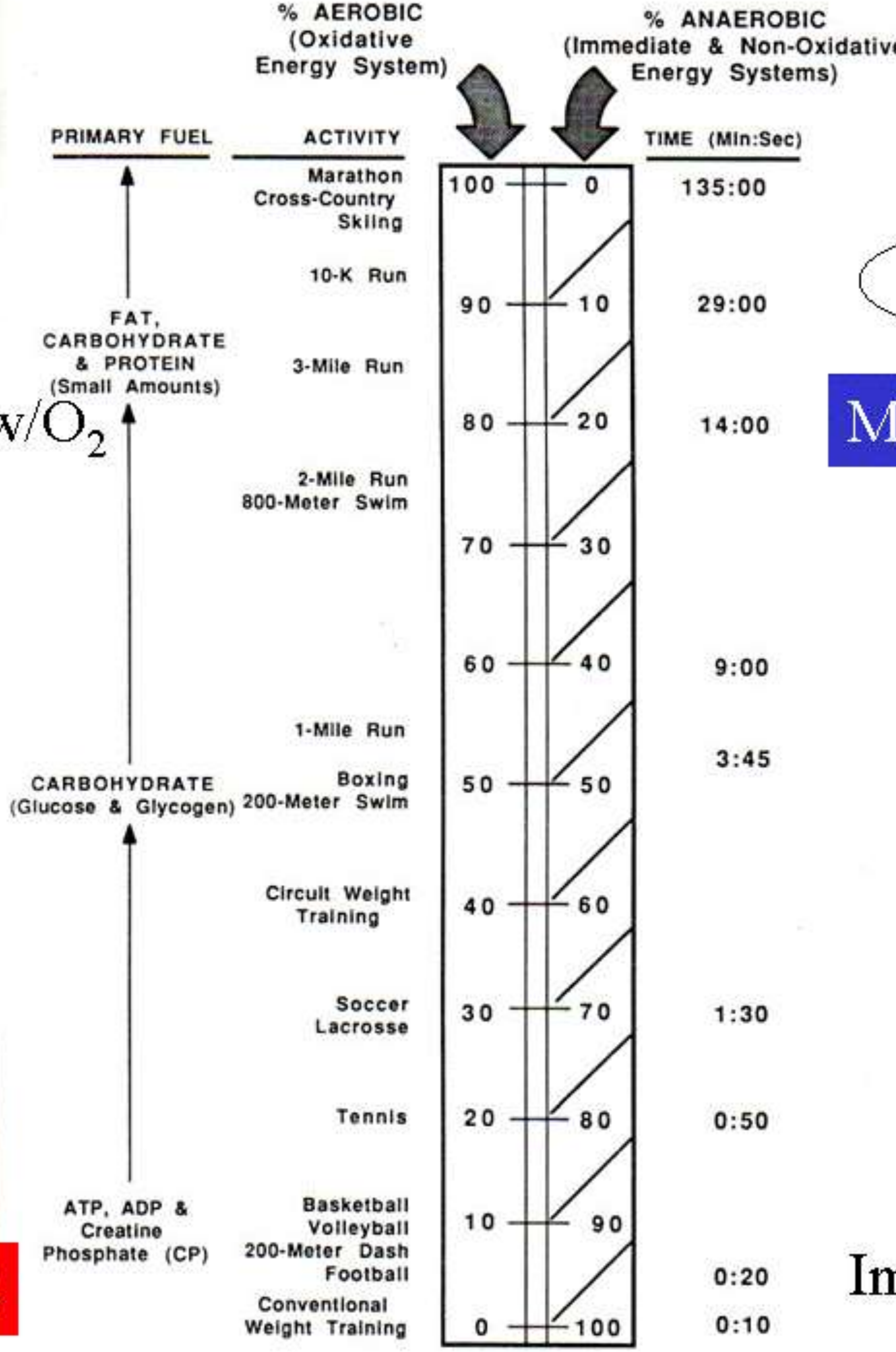


# *Characteristics of Skeletal Muscle Fibers*

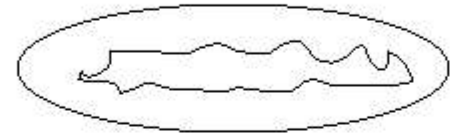
| Characteristic | TYPE OF FIBER<br>Slow Oxidative (Type I) | Fast Oxidative (Type IIa) | Fast Glycolytic (Type IIb) |
|---|---|---|---|
| Myosin-ATPase Activity | Low | High | High |
| Speed of Contraction | Slow | Fast | Fast |
| Resistance to Fatigue | High | Intermediate | Low |
| Aerobic Capacity | 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

AEROBIC w/$O_2$







MITOCHONDRIA

CYTOSOL

Glycolysis

Immediate/ATP-PC

ANAEROBIC

# ***Muscle Changes 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)?

# ***Muscle Changes 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:



45

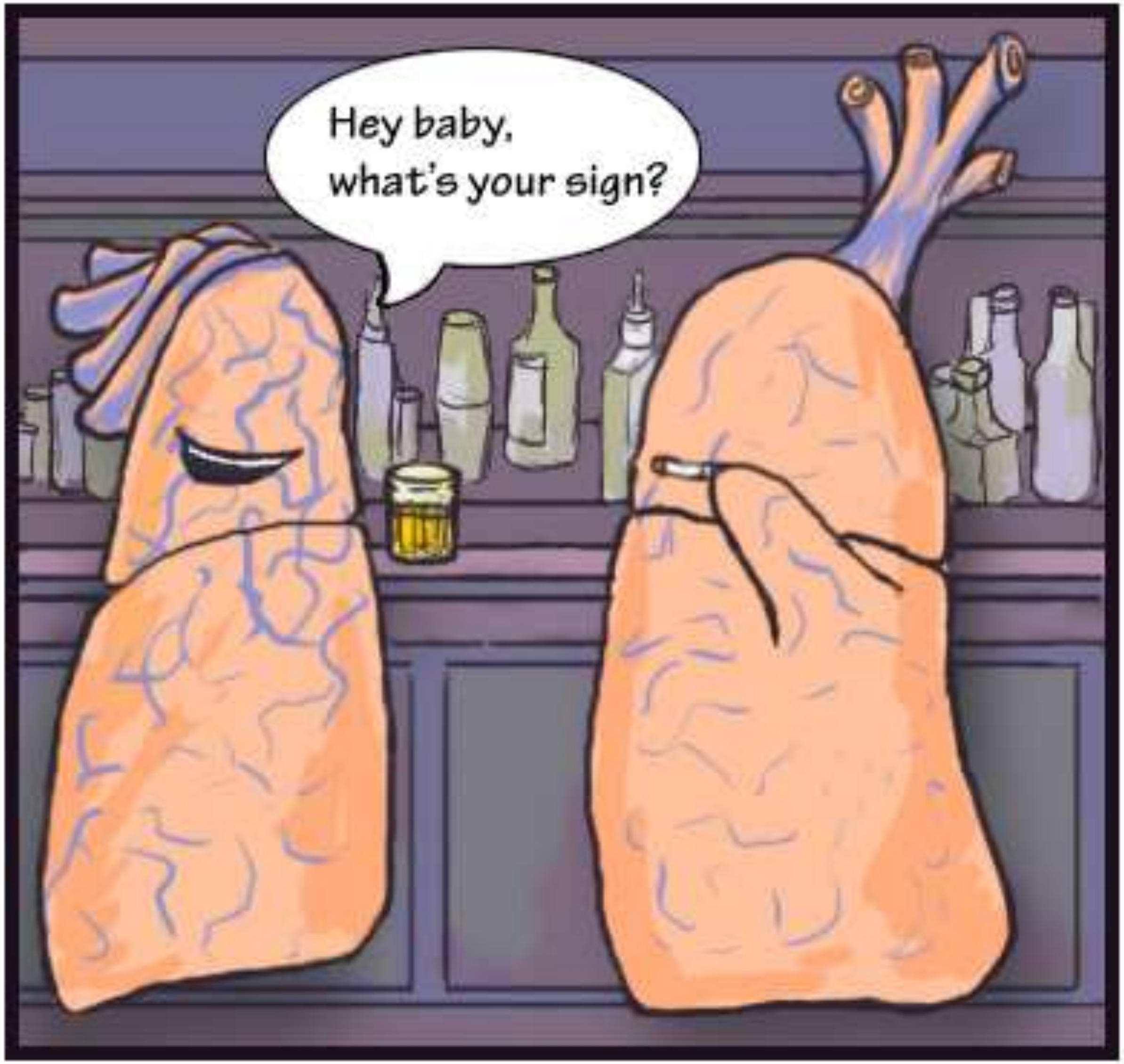




***Dancing can be super aerobic exercise, too, & you don't have to be a star!***

# Extremes of the energy continuum!

# *Discussion + Time for Questions!*

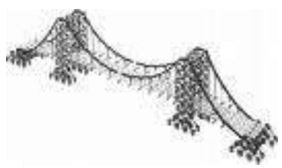



Cancer.

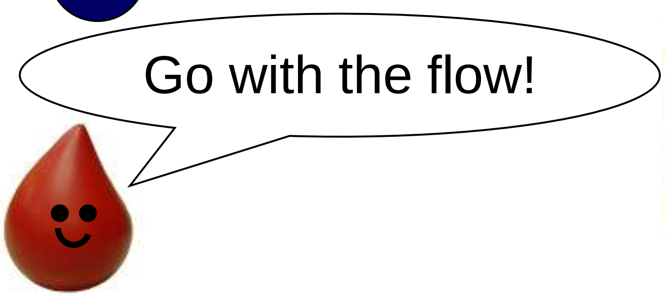
# Lombo's simplified steps!

1 **Breathe in & out!**

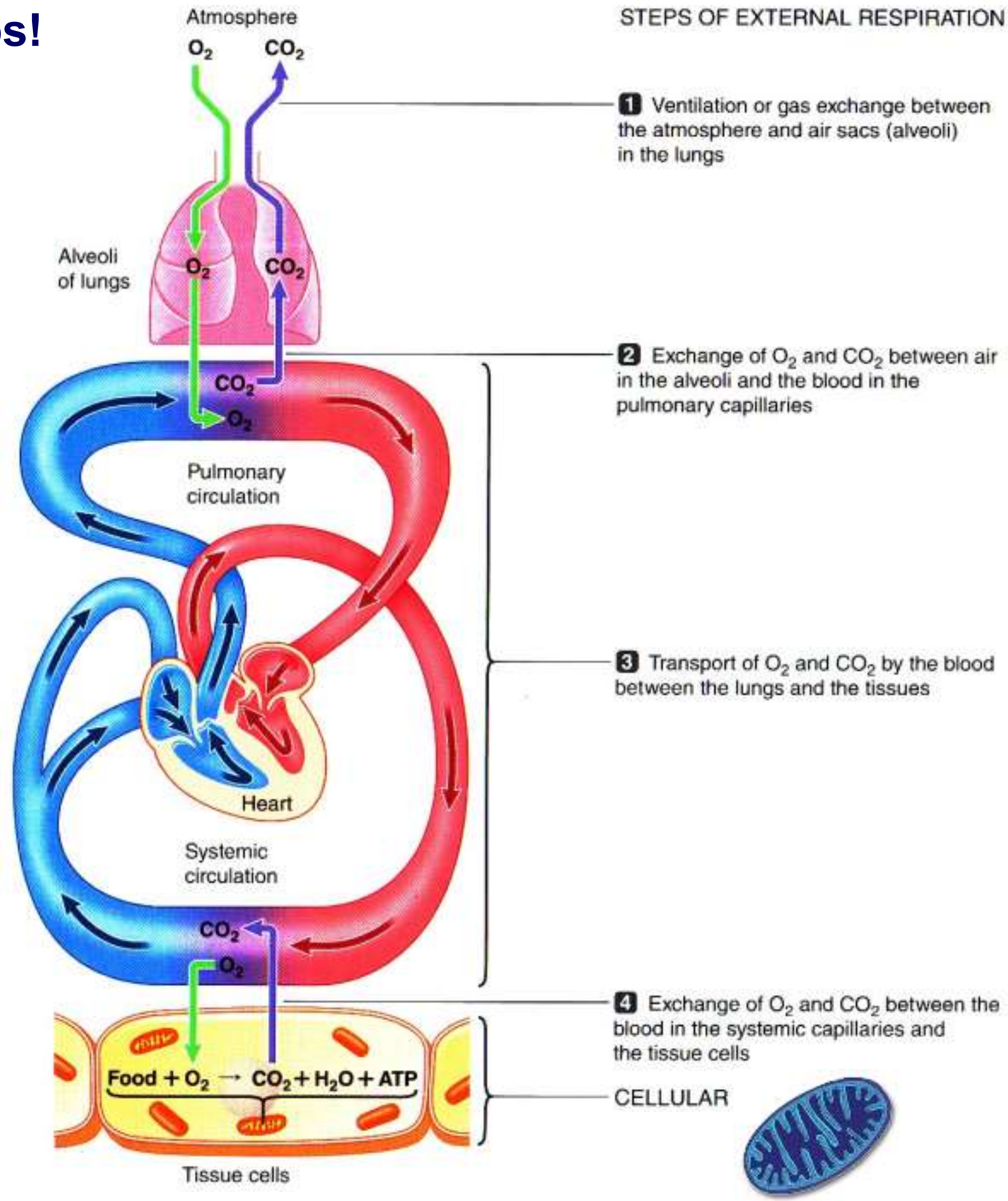
2 **Cross membranes!**



3 **Move with blood!**



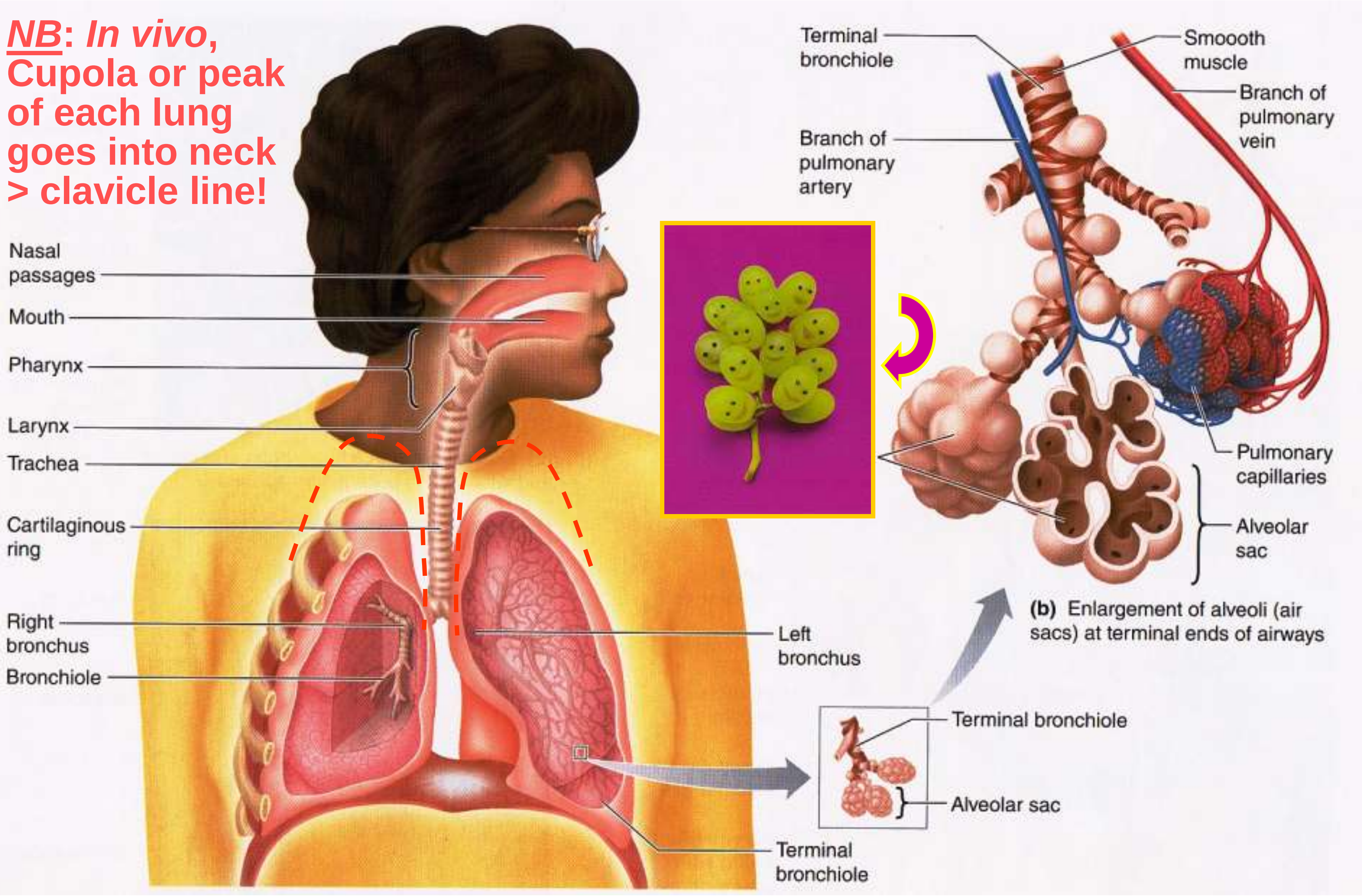

4 **Cross membranes!**



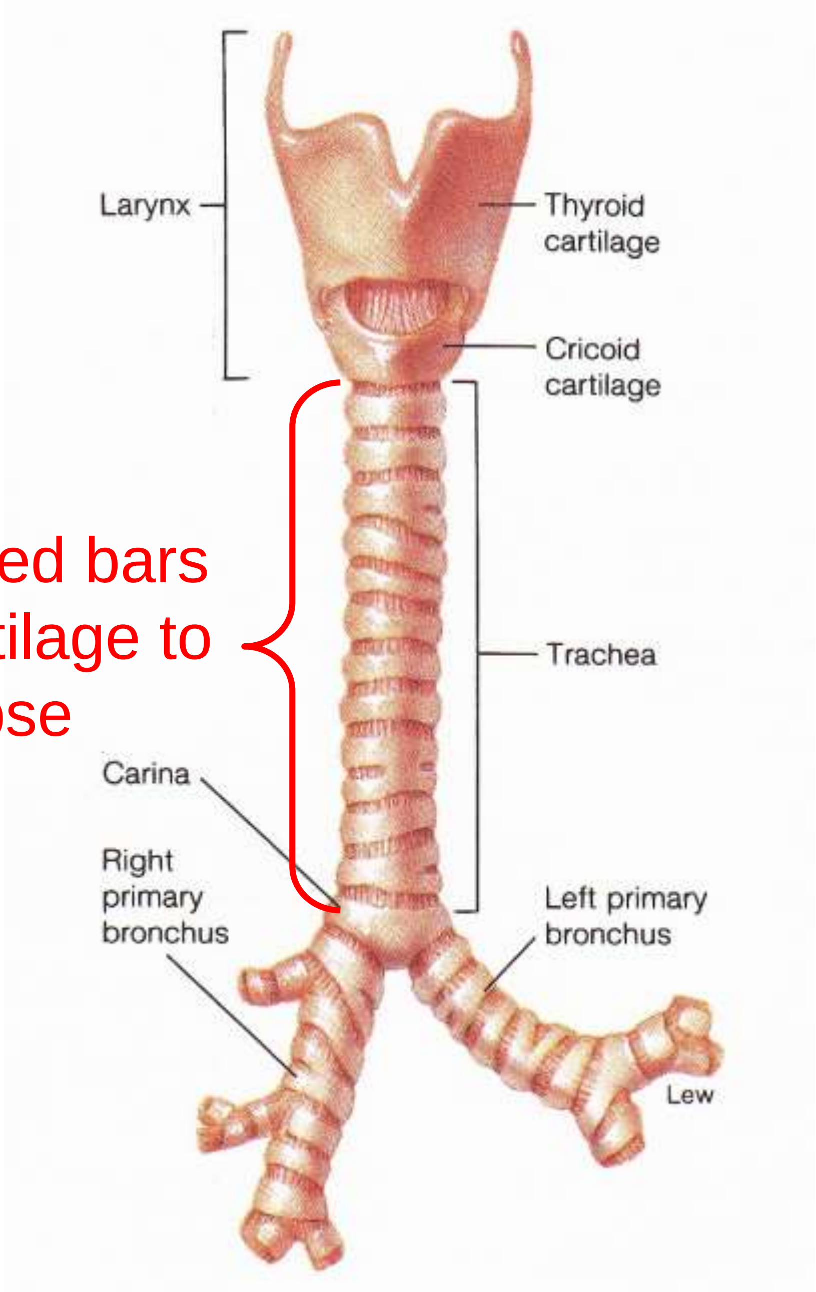

LS 2012 fig 12-1 modified

# Respiratory System Anatomy

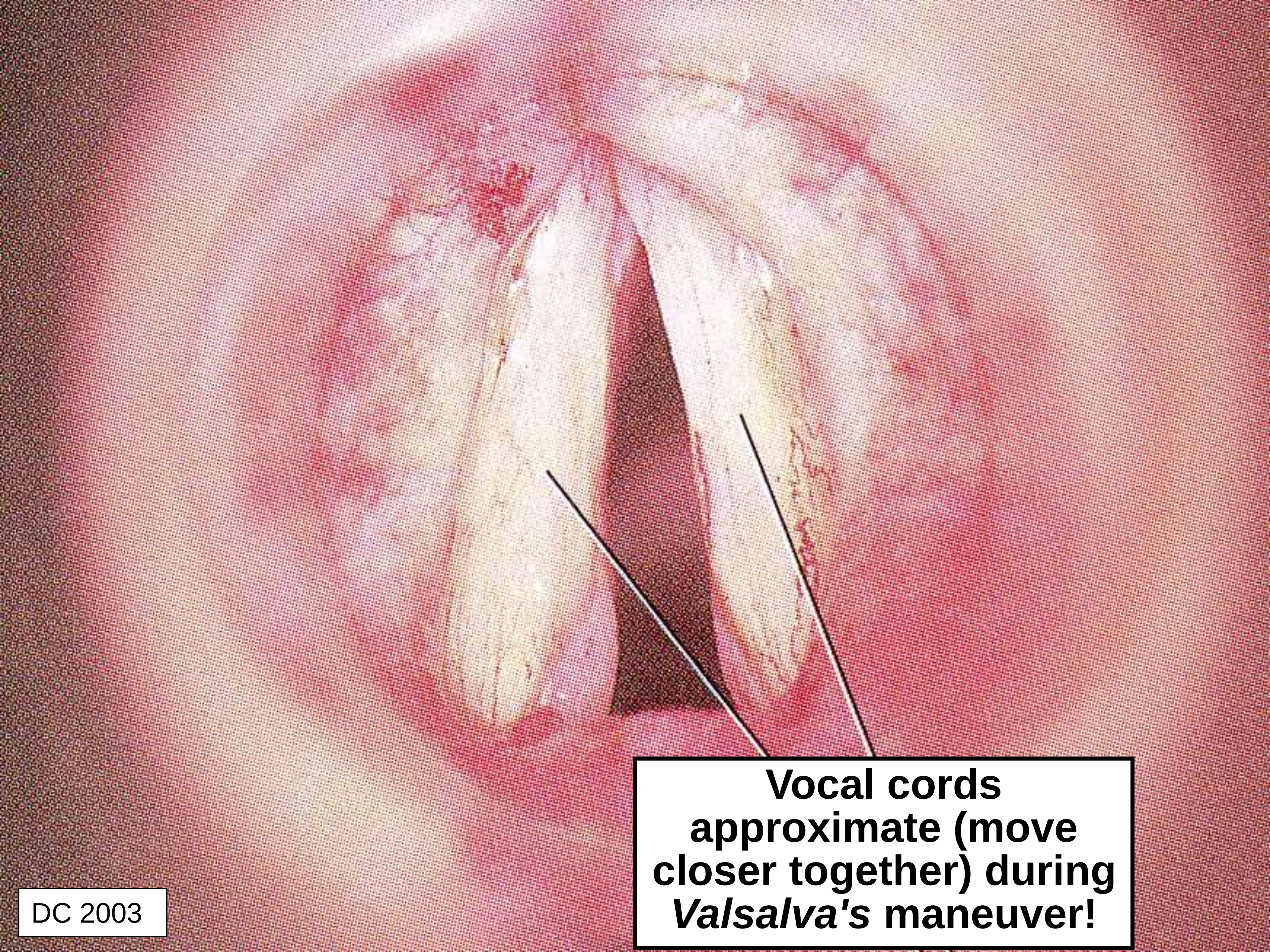
***NB*: *In vivo*, Cupola or peak of each lung goes into neck > clavicle line!**



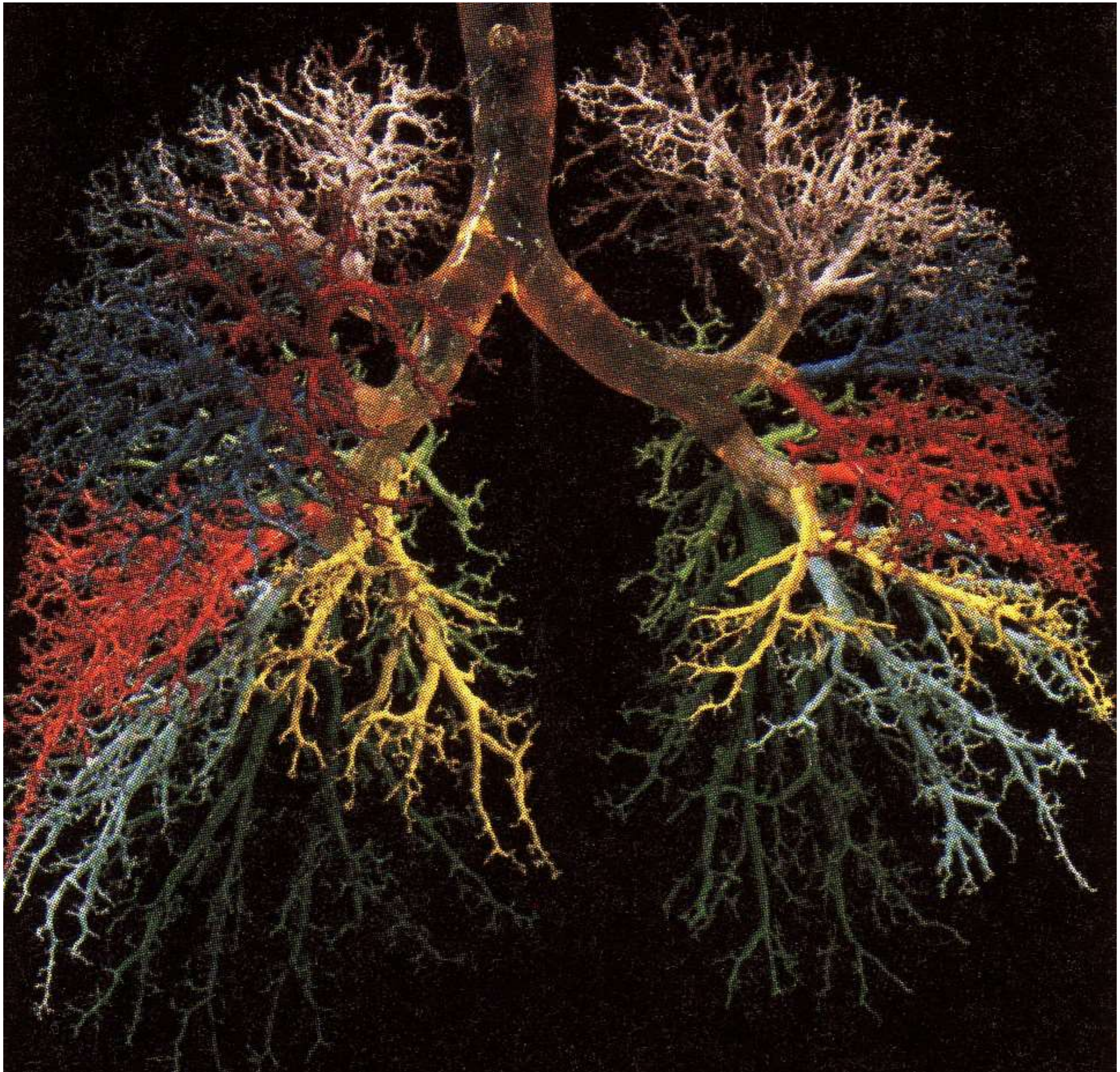

LS 2012 fig 12-2



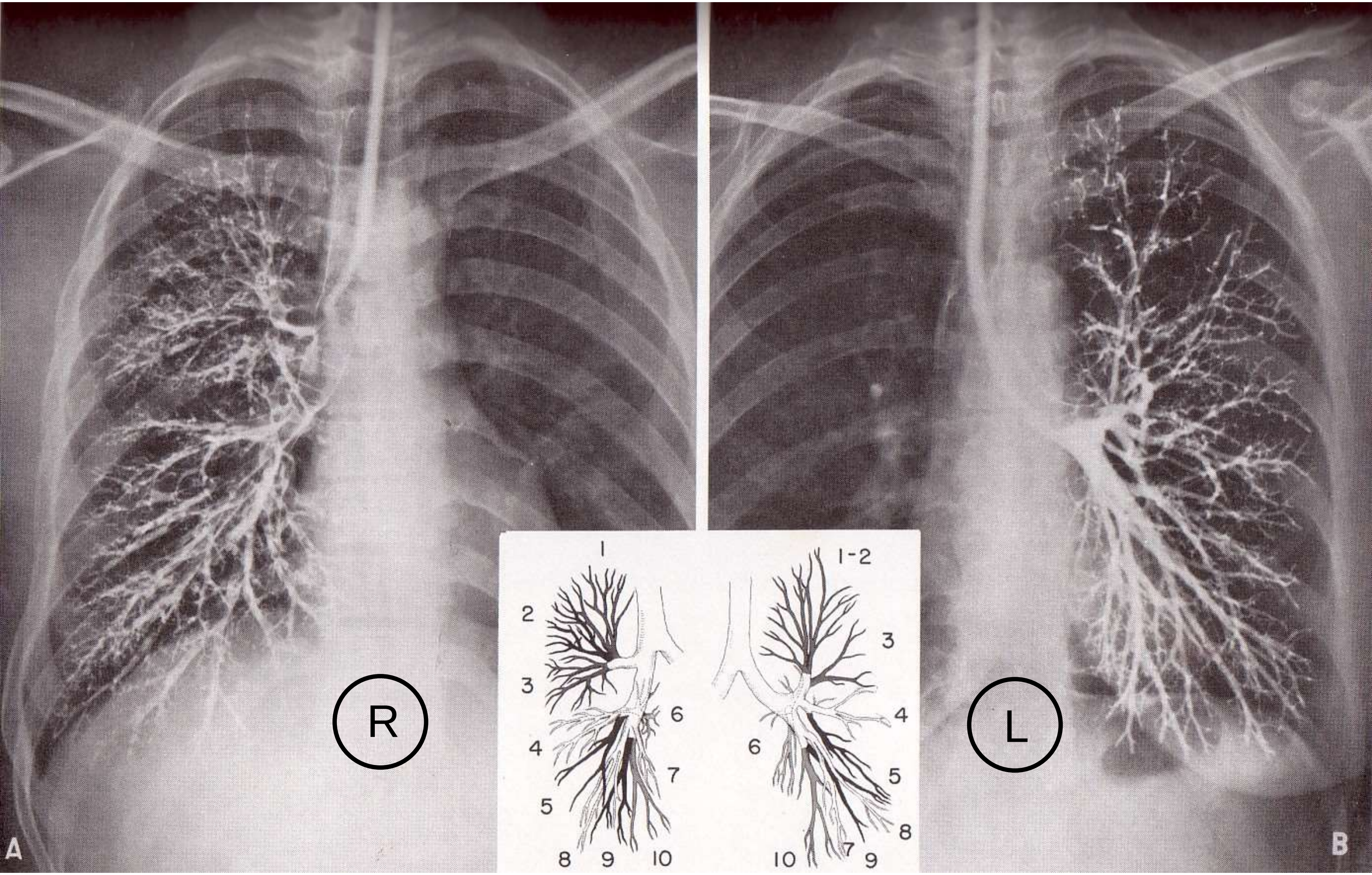

16-20 C-shaped bars of hyaline cartilage to prevent collapse


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

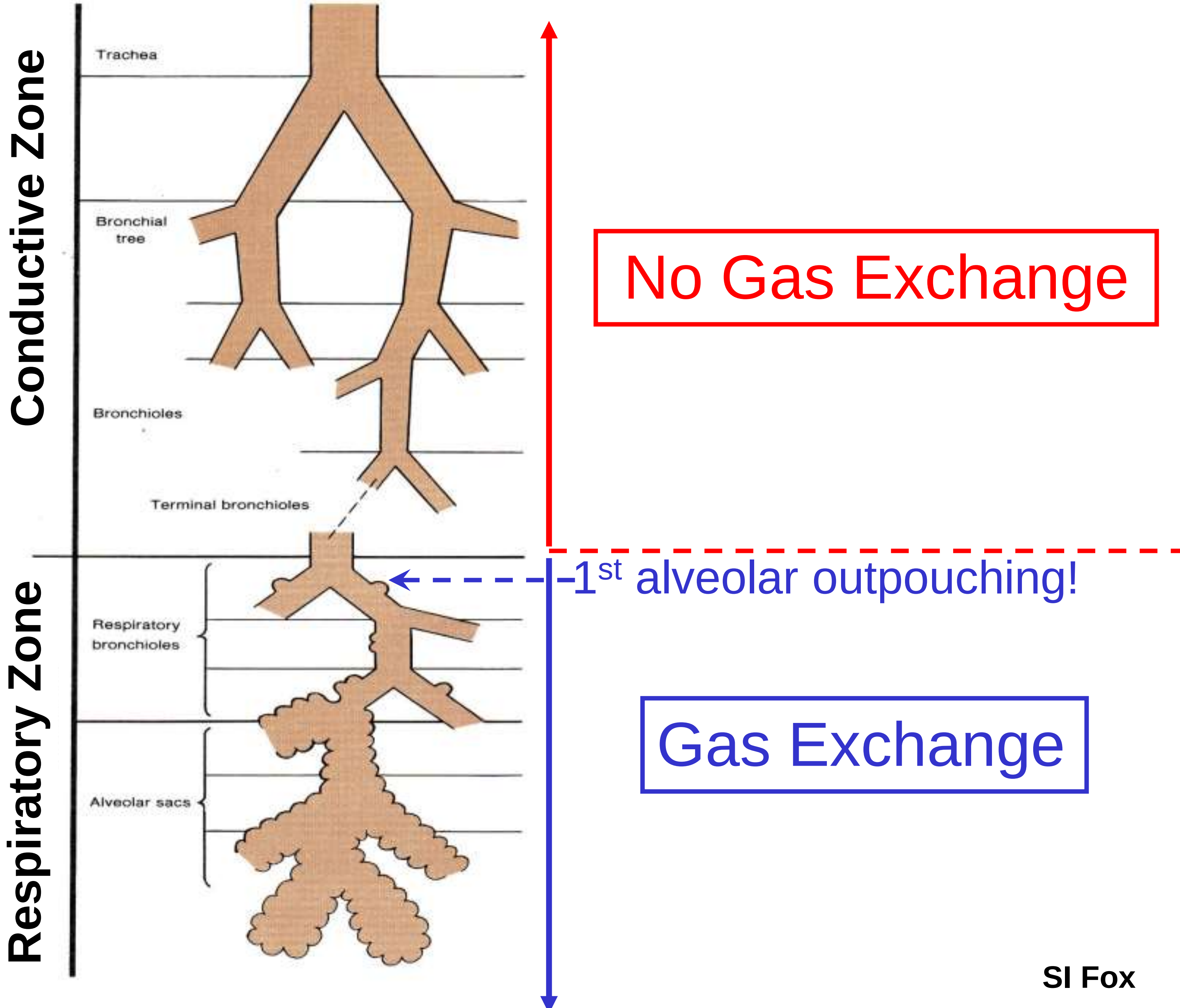
# *Pulmonary Latex Cast with Colored Segmentation*



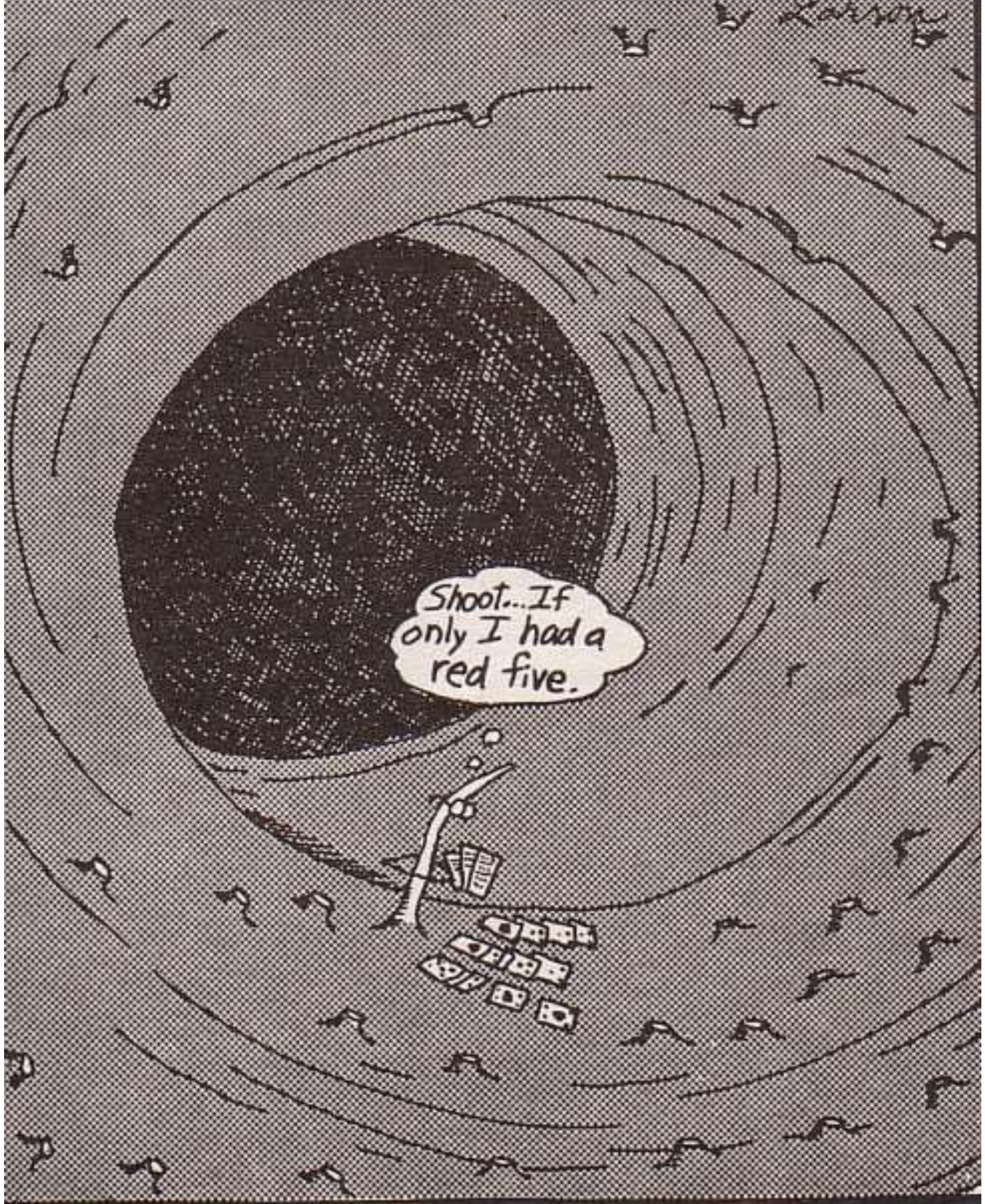
# ***Bronchograms (posteroanterior)***



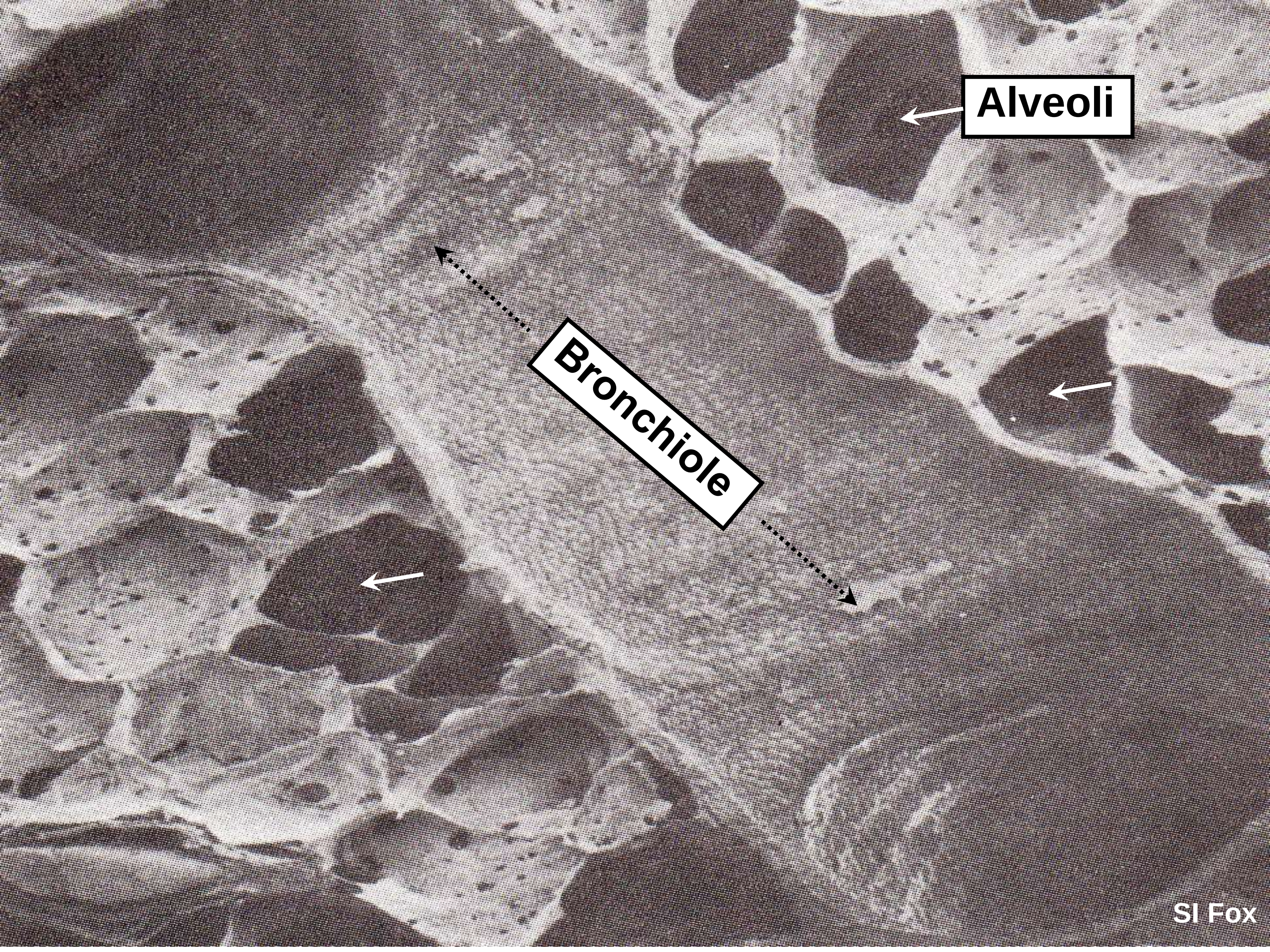

<u>*Source*</u>: Gardner, Gray, O'Rahilly, *Anatomy*, fig 29-11, p 295.

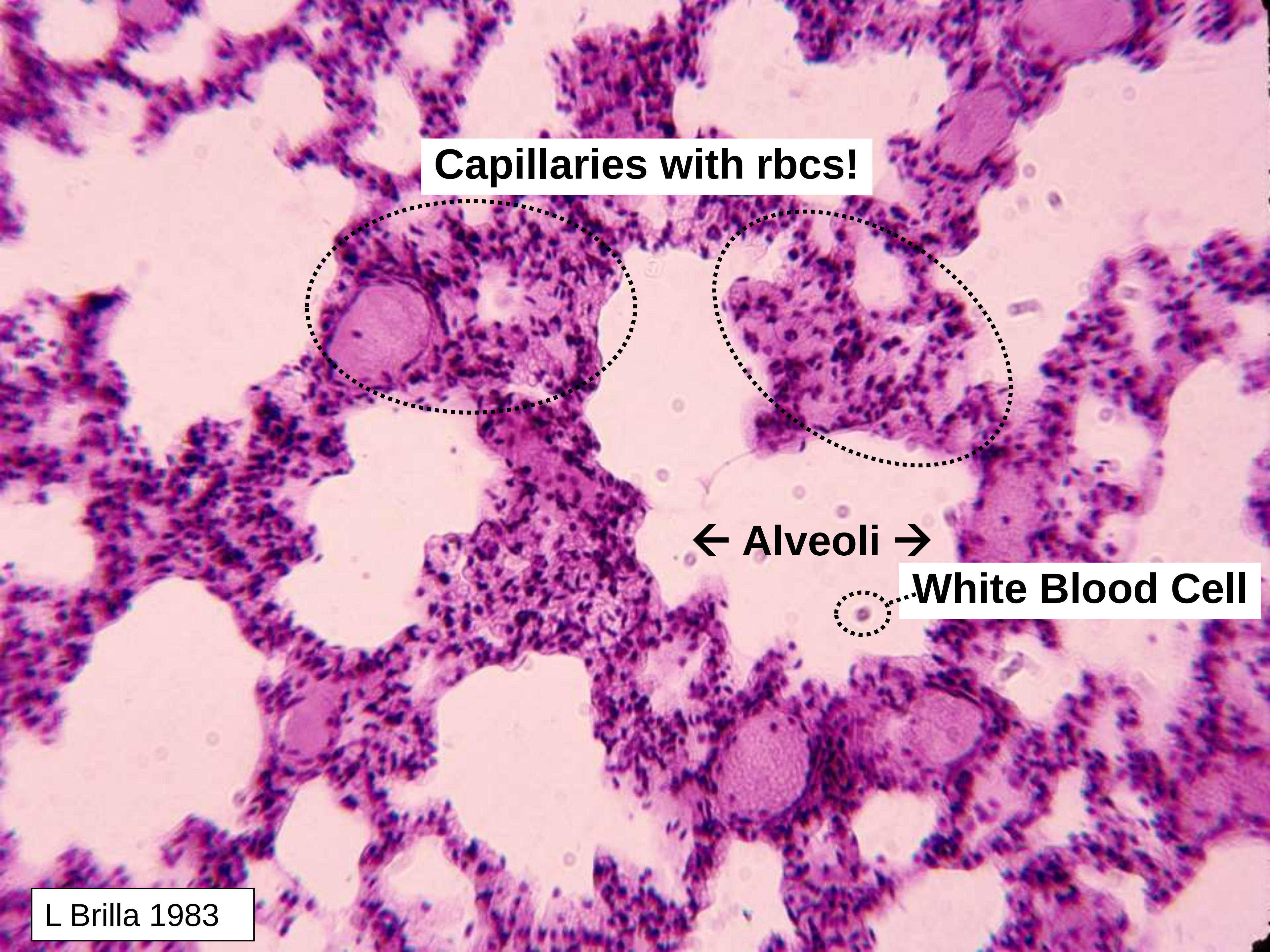

Conductive Zone
Respiratory Zone
Trachea
Bronchial tree
Bronchioles
Terminal bronchioles
Respiratory bronchioles
Alveolar sacs
No Gas Exchange
1st alveolar outpouching!
Gas Exchange

SI Fox



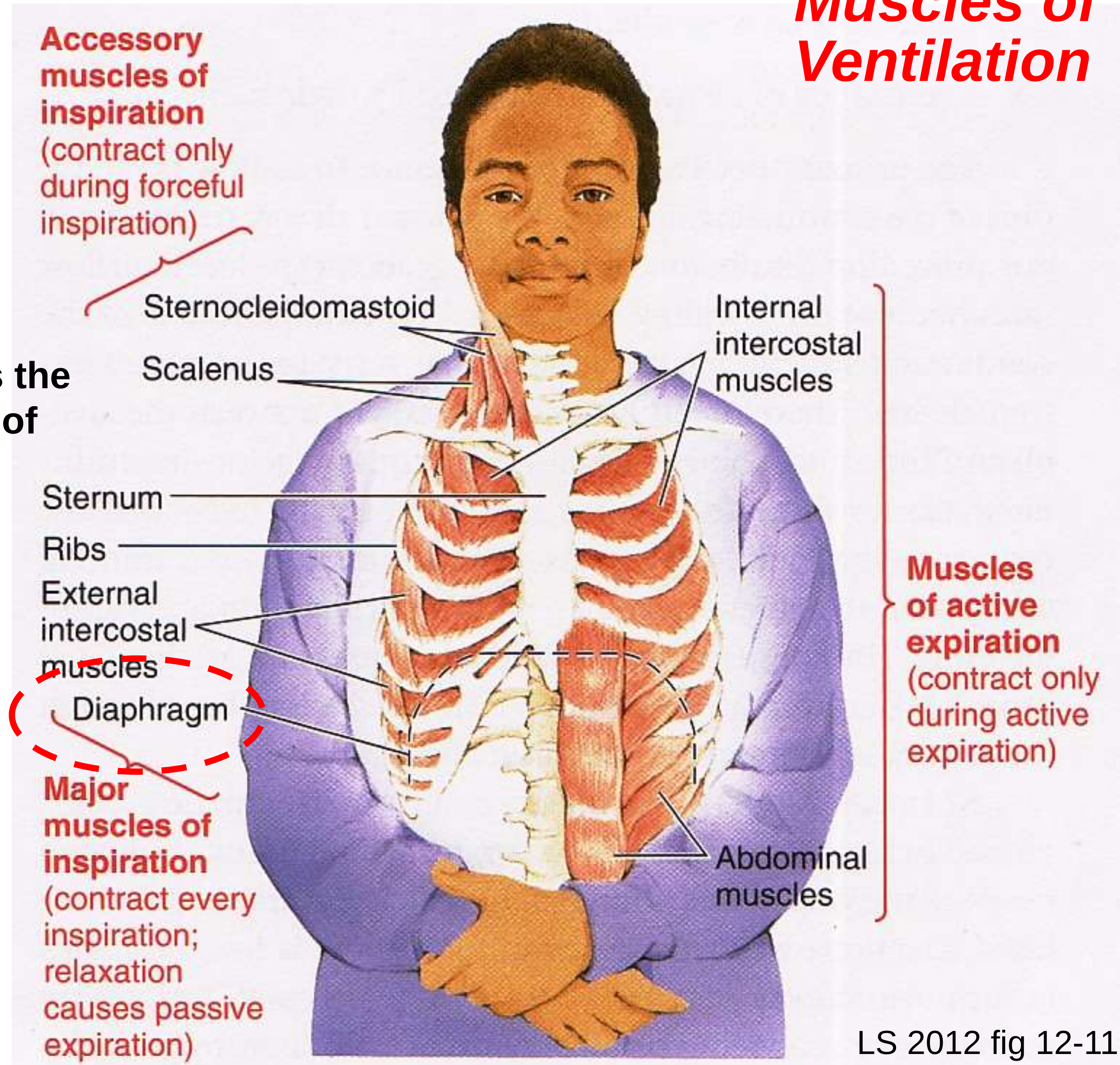

The last cilium on a smoker's lung


Alveoli
Bronchiole
SI Fox

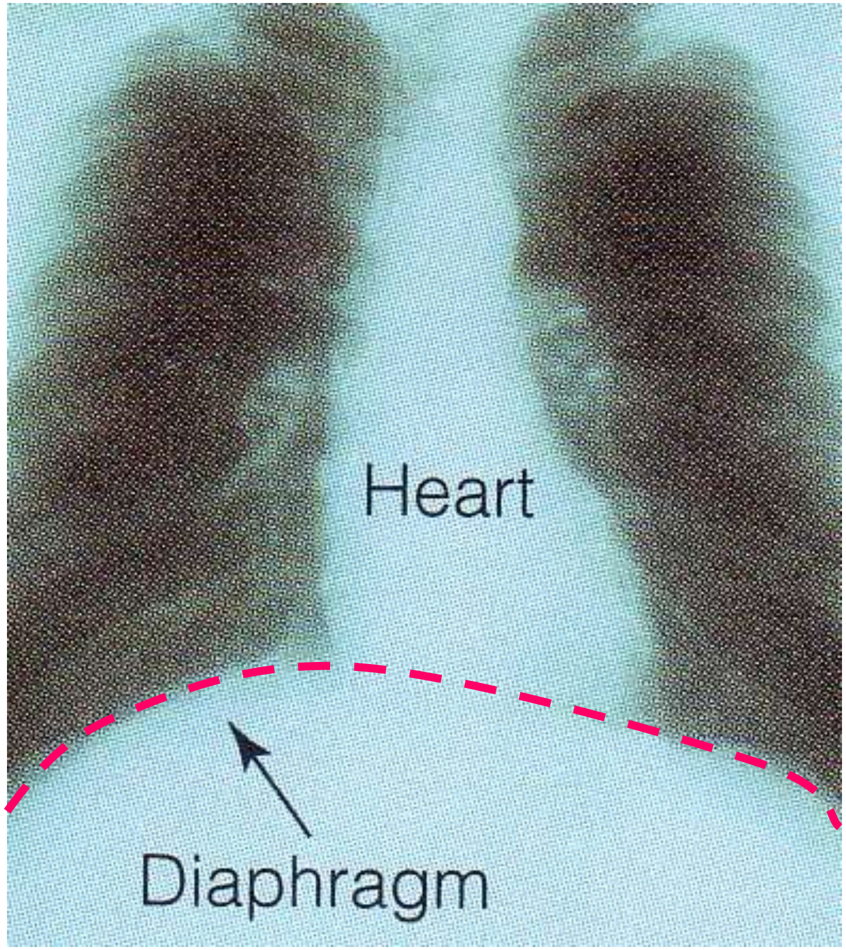

Capillaries with rbcs!
← Alveoli →
White Blood Cell
L Brilla 1983

# *Muscles of Ventilation*

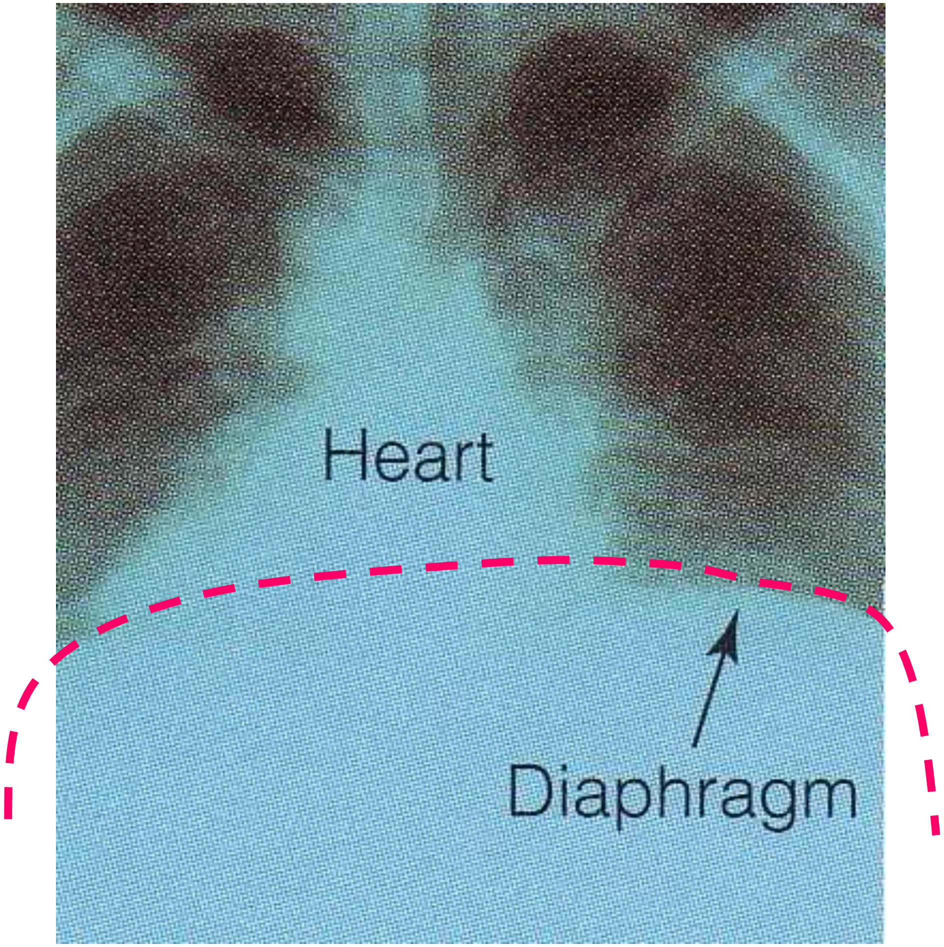
**NB**: **Diaphragm is the chief muscle of ventilation!**




LS 2012 fig 12-11




*Inhale* (active)

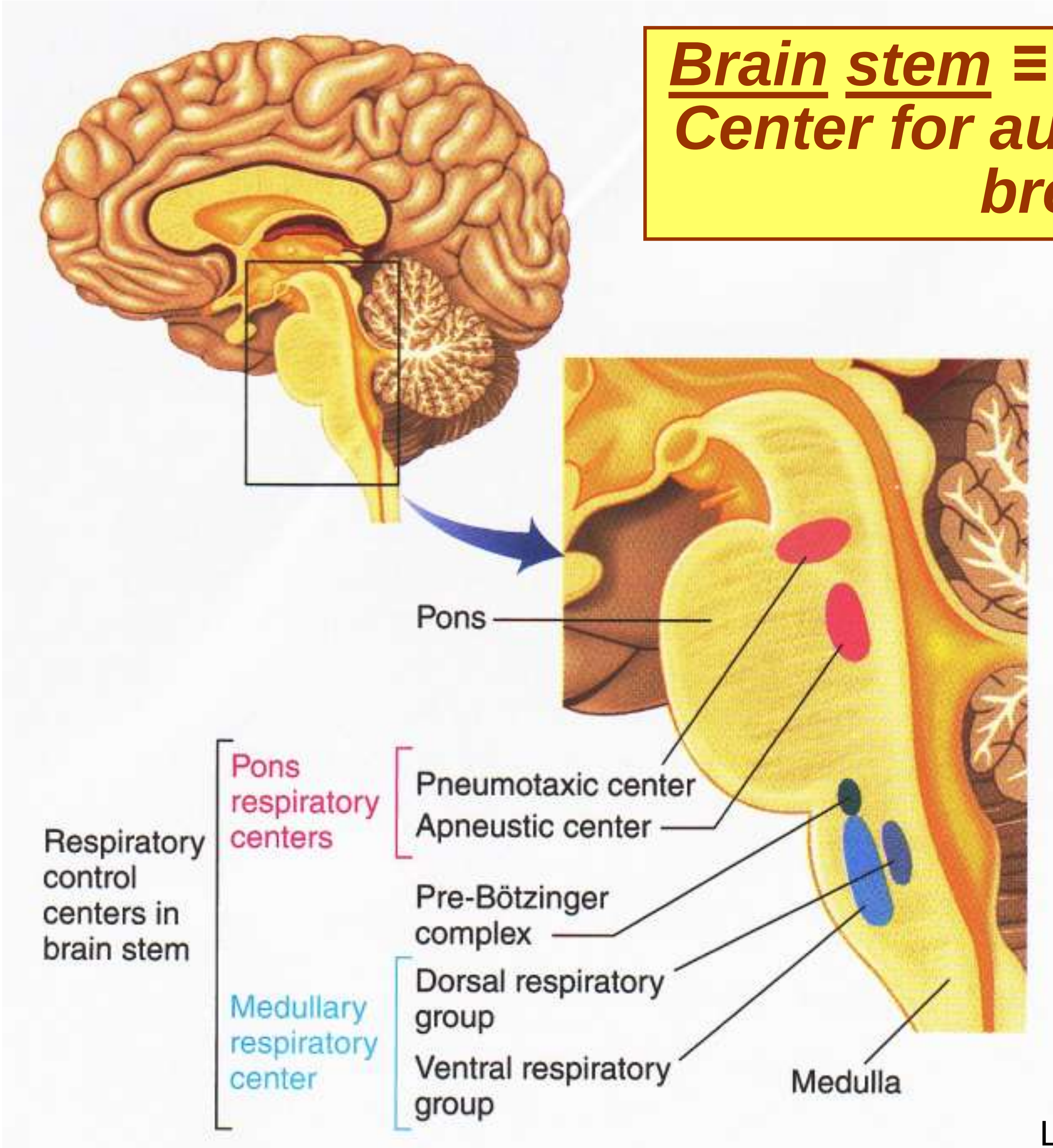



*Exhale* (passive @ rest)

**Contract & flatten diaphragm**

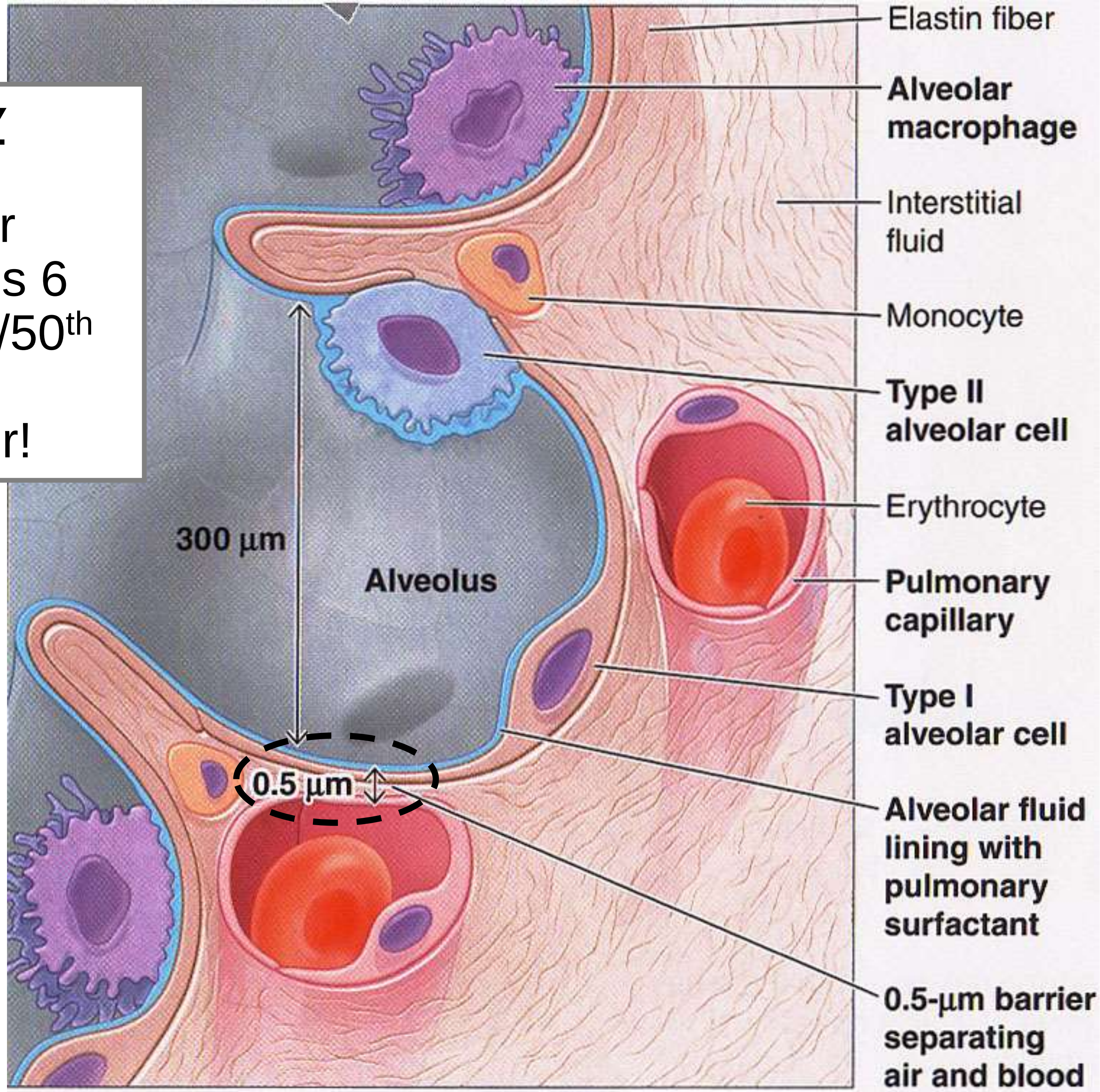
**Relax & pouch up diaphragm!**

## **Brain stem ≡ Control Center for automatic breathing!**



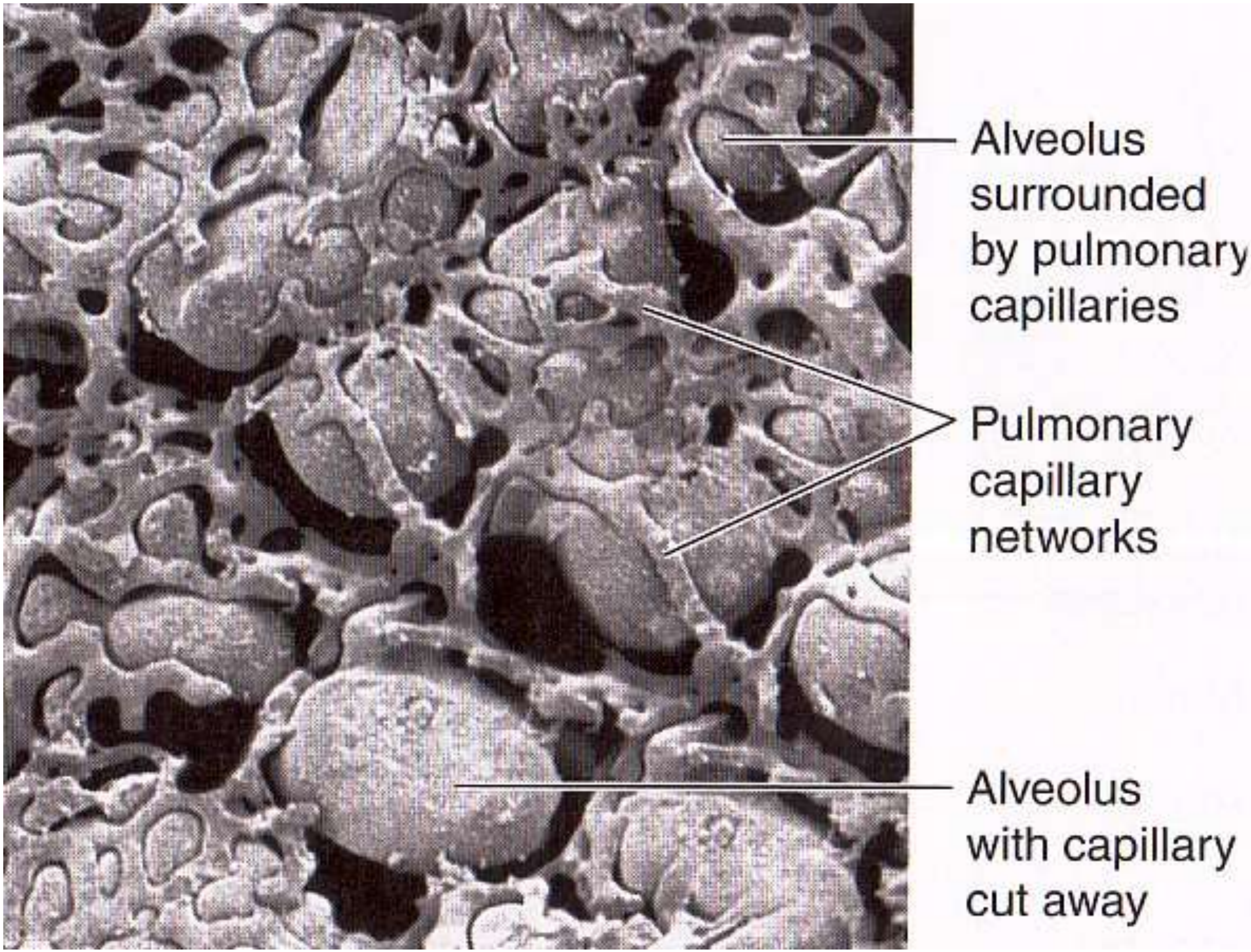

LS 2012 fig 12-25

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




LS 2012 fig 12-4a
cf: DC 2013 fig 7-4

# *Alveoli are surrounded by jackets of capillaries!*

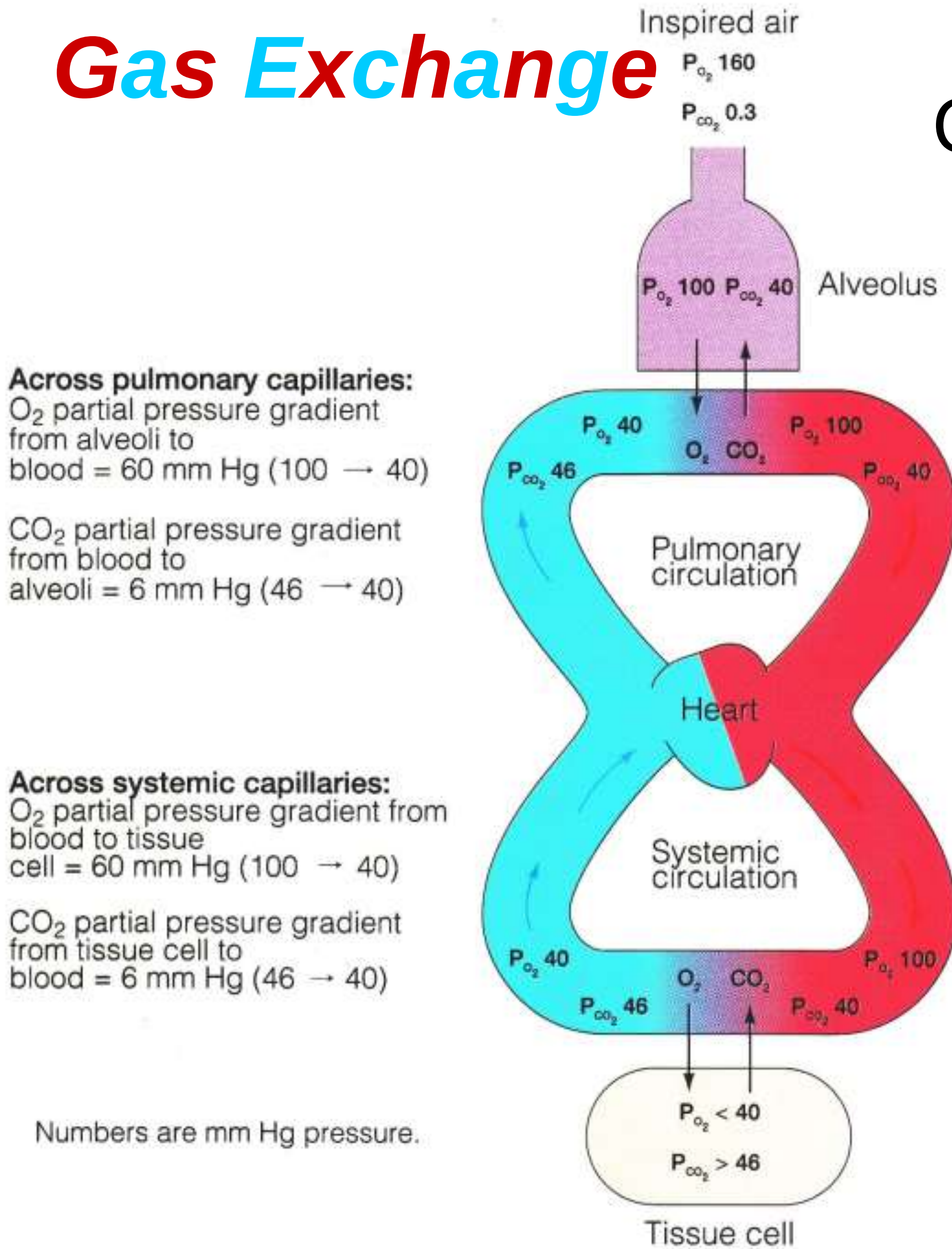



LS 2012 fig 12-4b

# Gas Exchange

$CO_2$ LOW

$O_2$ HIGH




$CO_2$ HIGH

$O_2$ LOW

cf: LS 2012 fig 12-19