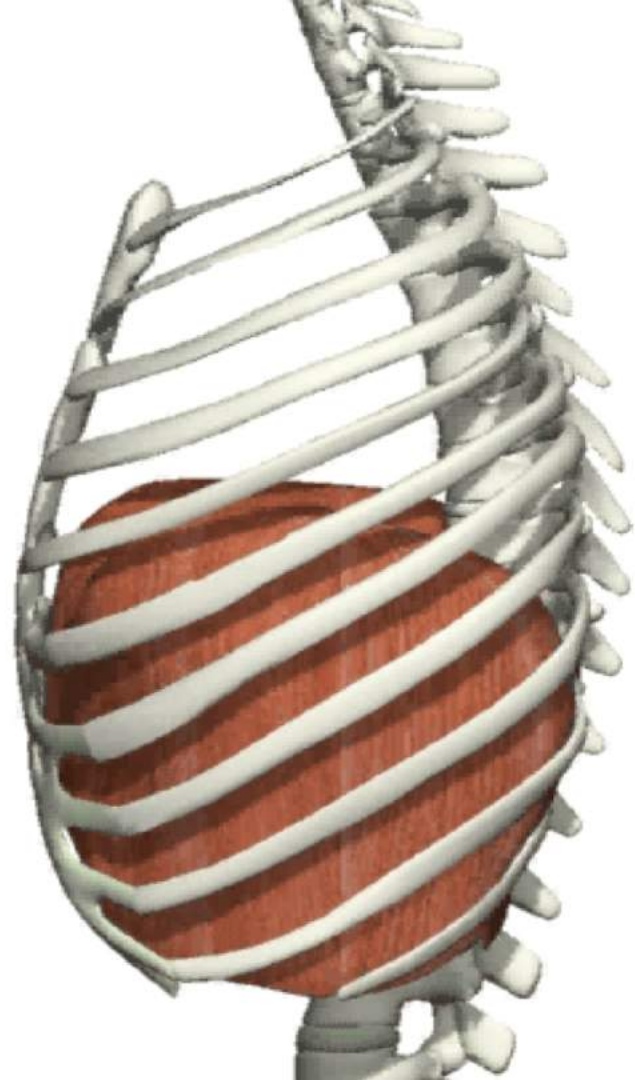
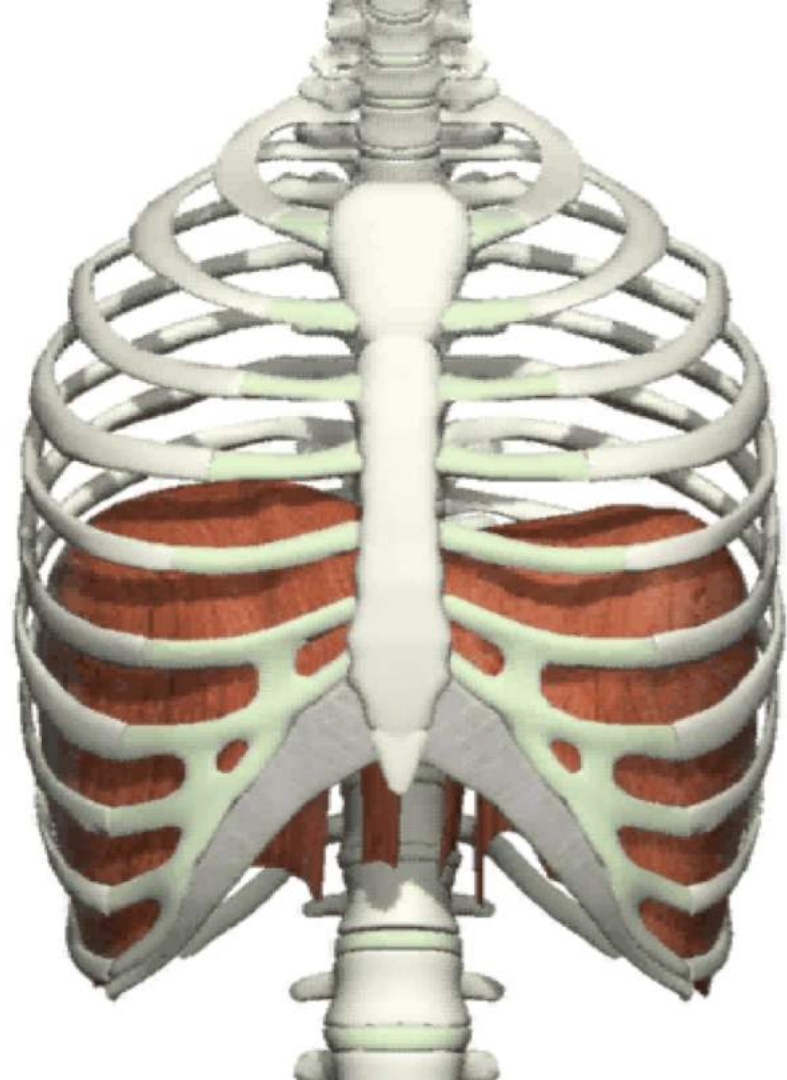


# Beademing: de basis



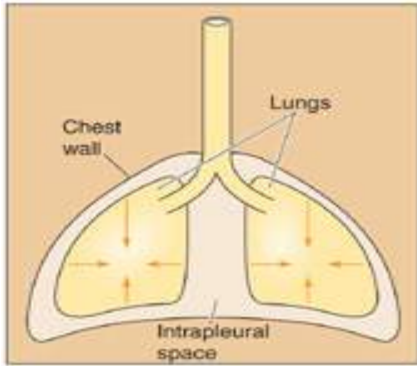
**Diederik Gommers  
Intensivist**



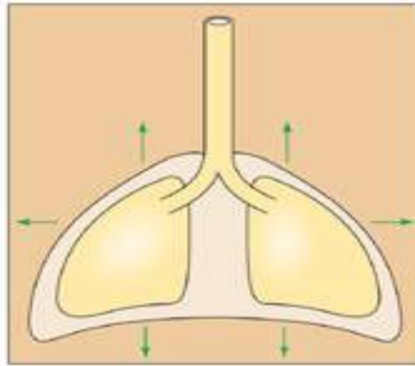


*Ezraus*

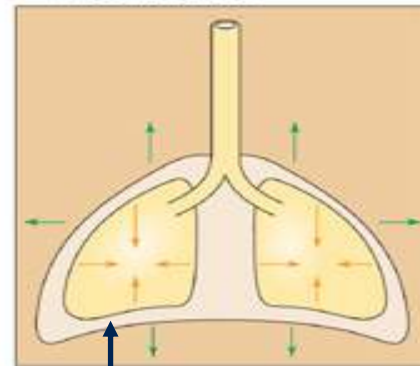
A ELASTIC RECOIL OF LUNGS



B ELASTIC RECOIL OF CHEST WALL

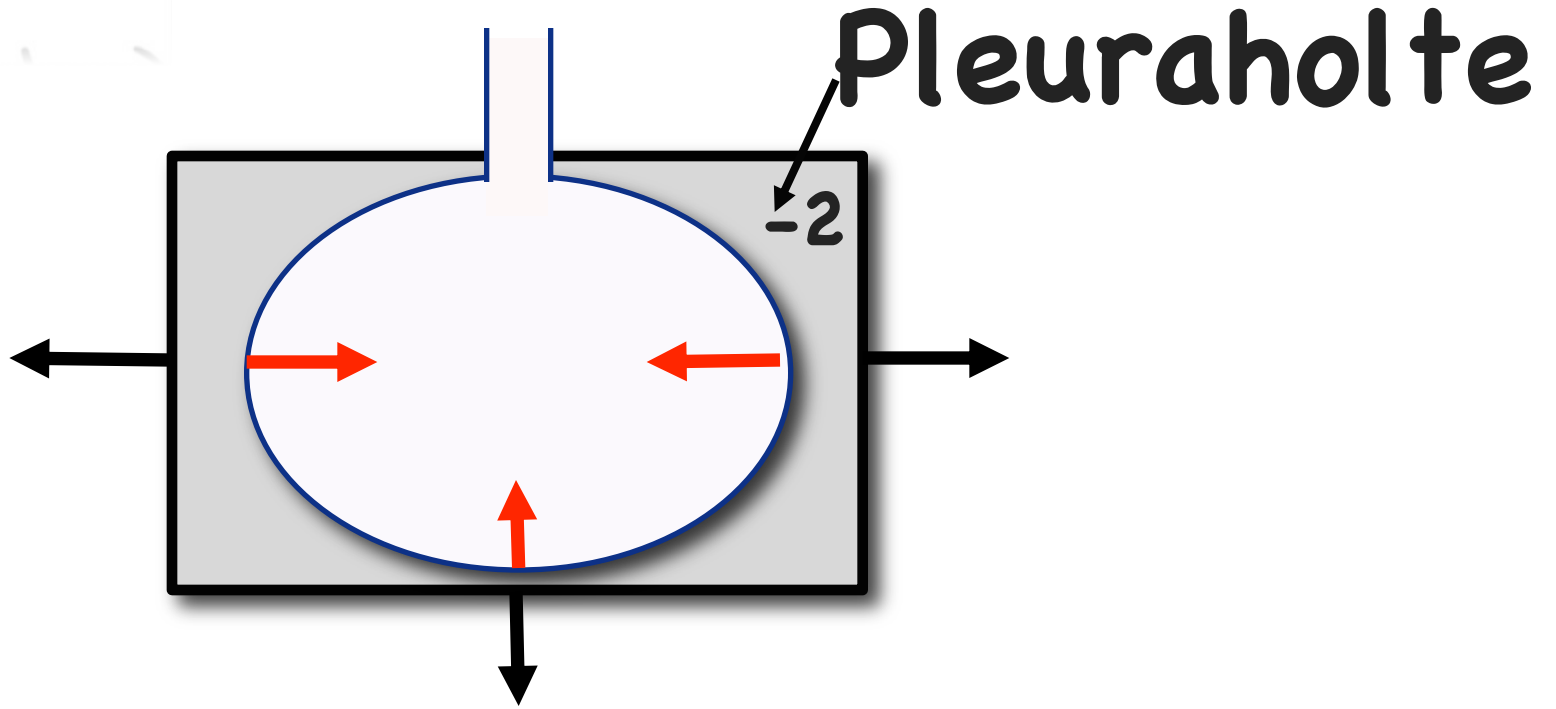


C ELASTIC RECOILS OF LUNGS AND CHEST WALL IN BALANCE



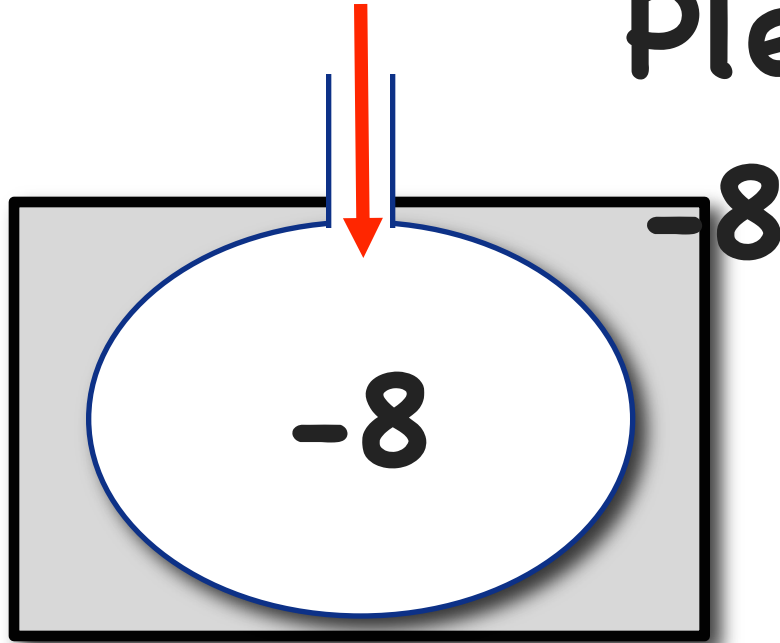
**FRC = functionele residuale capaciteit**

*Exkurs*

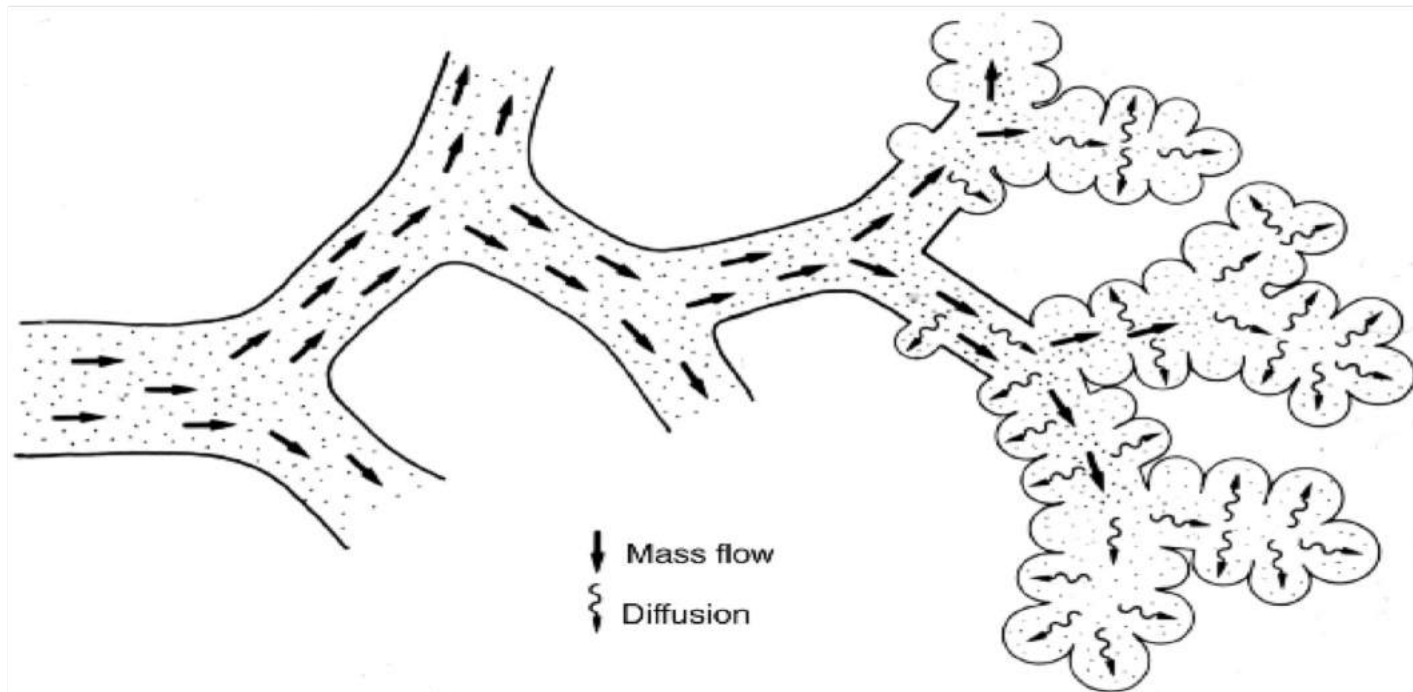


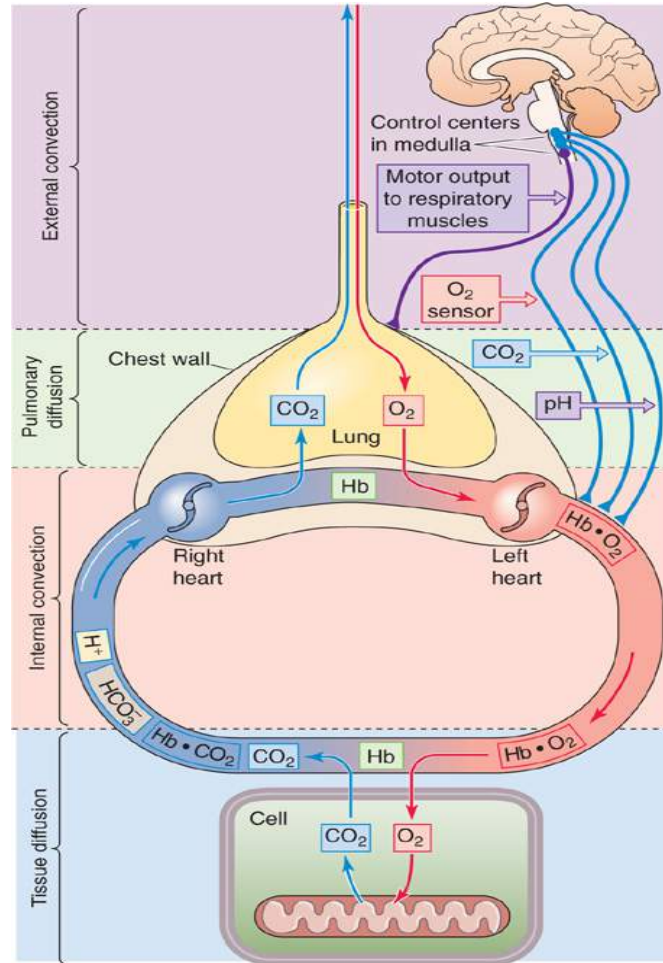
**1 atm = 760 mmHg = 100 kPa**

# Pleuraholte

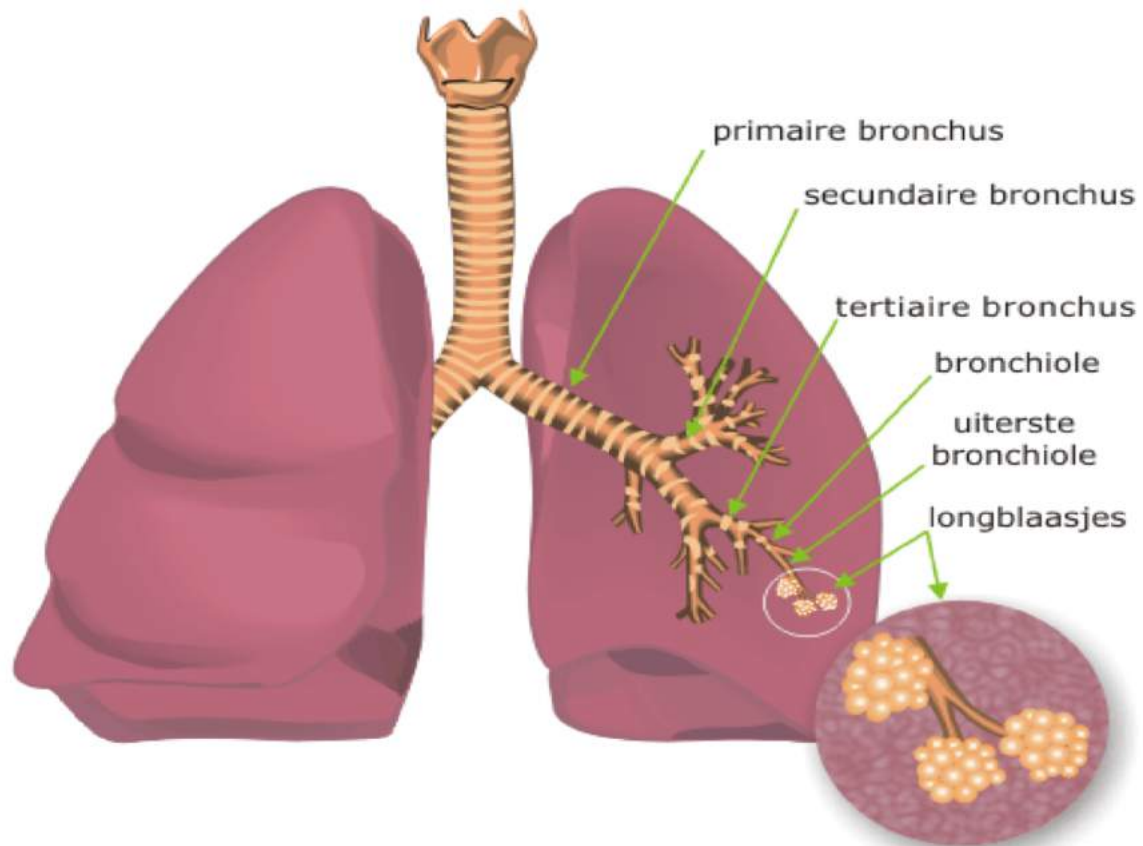


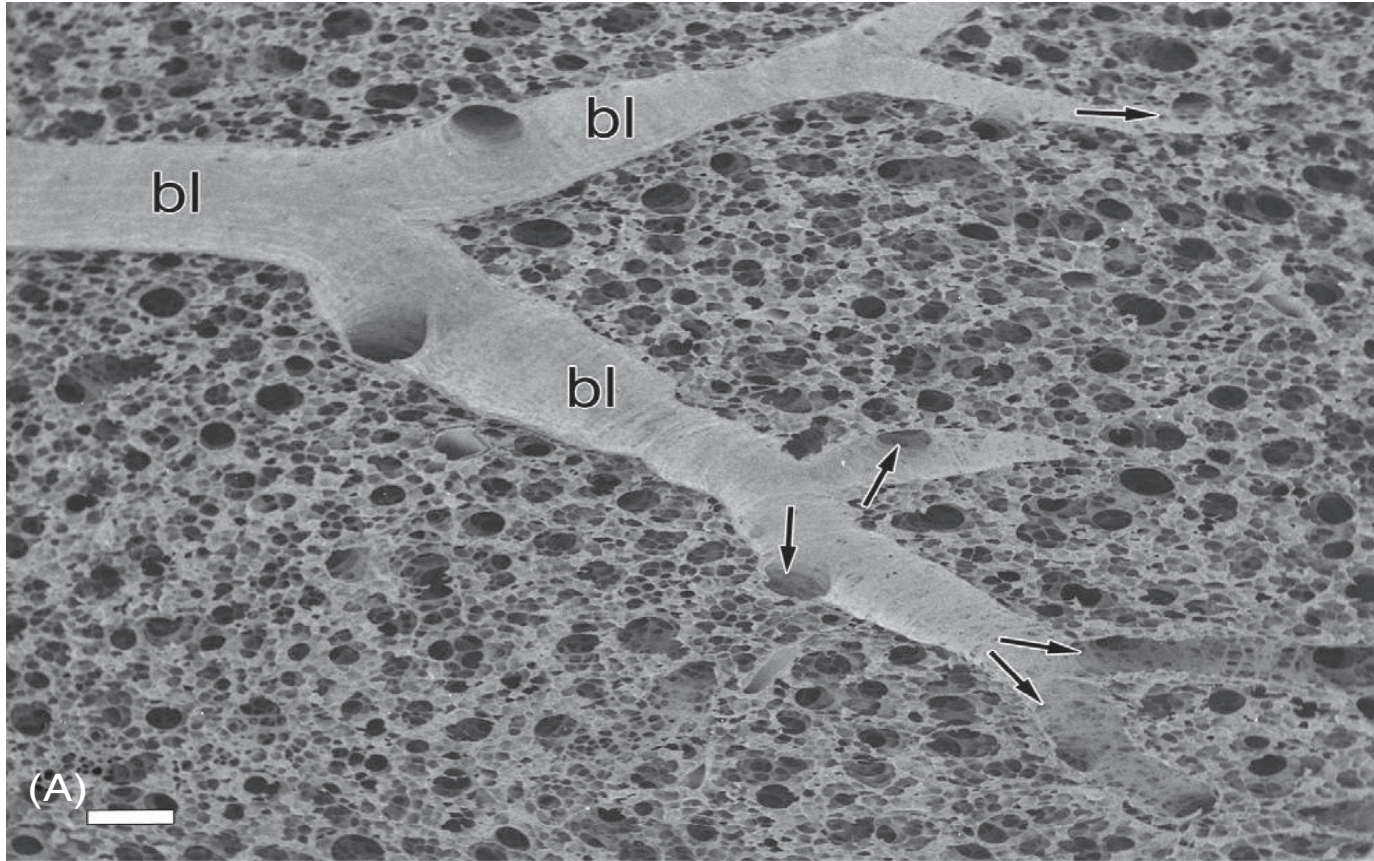
*The pressure difference between the mouth and alveoli is normally no greater than  $-1$  cmH<sub>2</sub>O.*

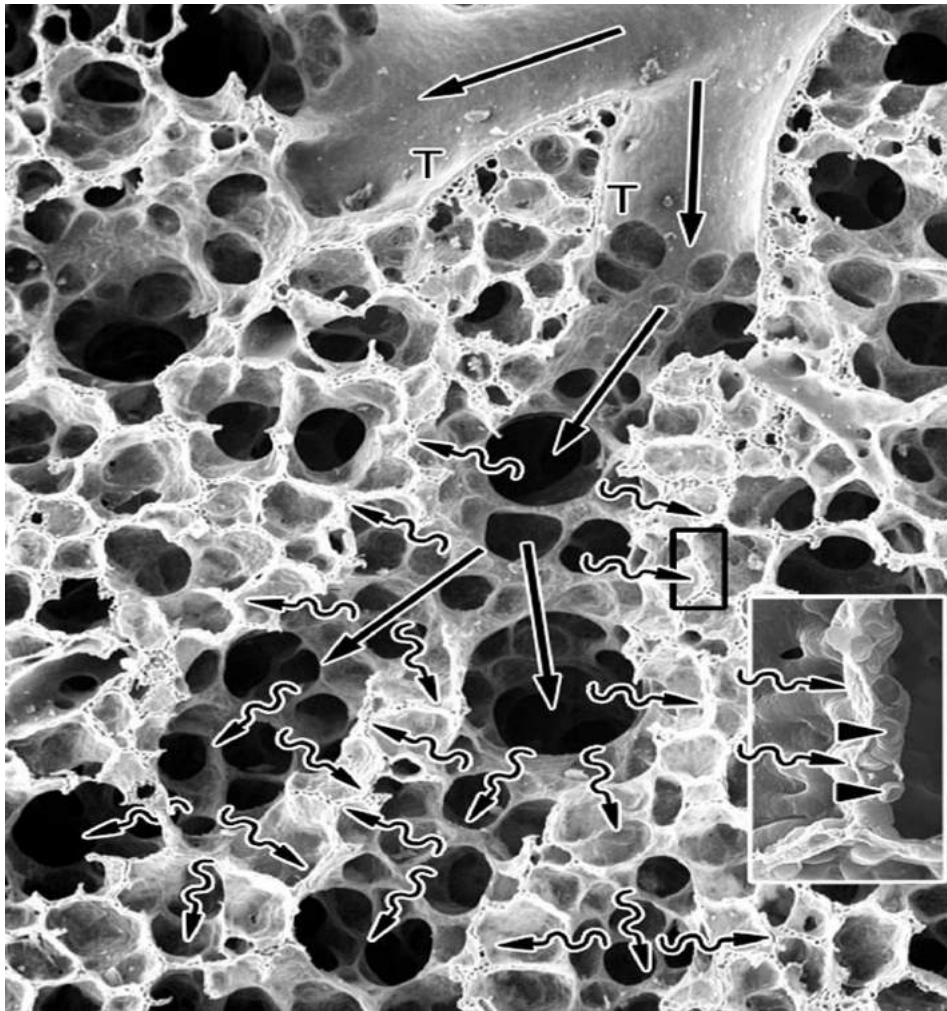








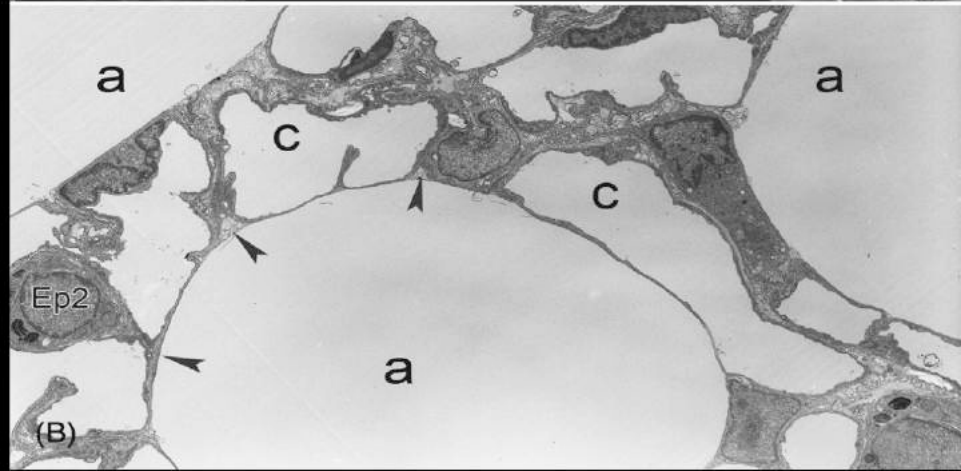
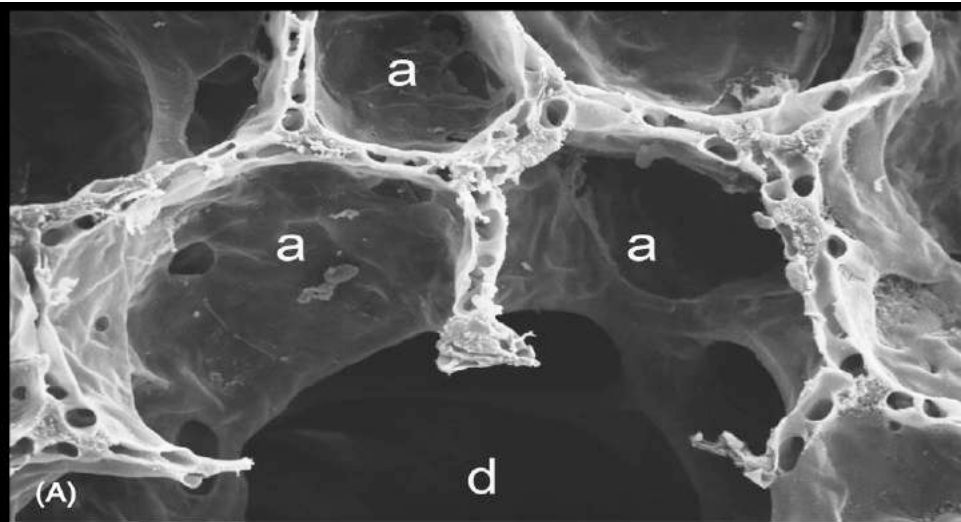




T = transitional  
bronchioli

Straight arrows:  
convection

Wiggly arrows:  
diffusion



Rabbit lung:

60% TLC

a = alveoli

d = alveolar duct

c = capillaries

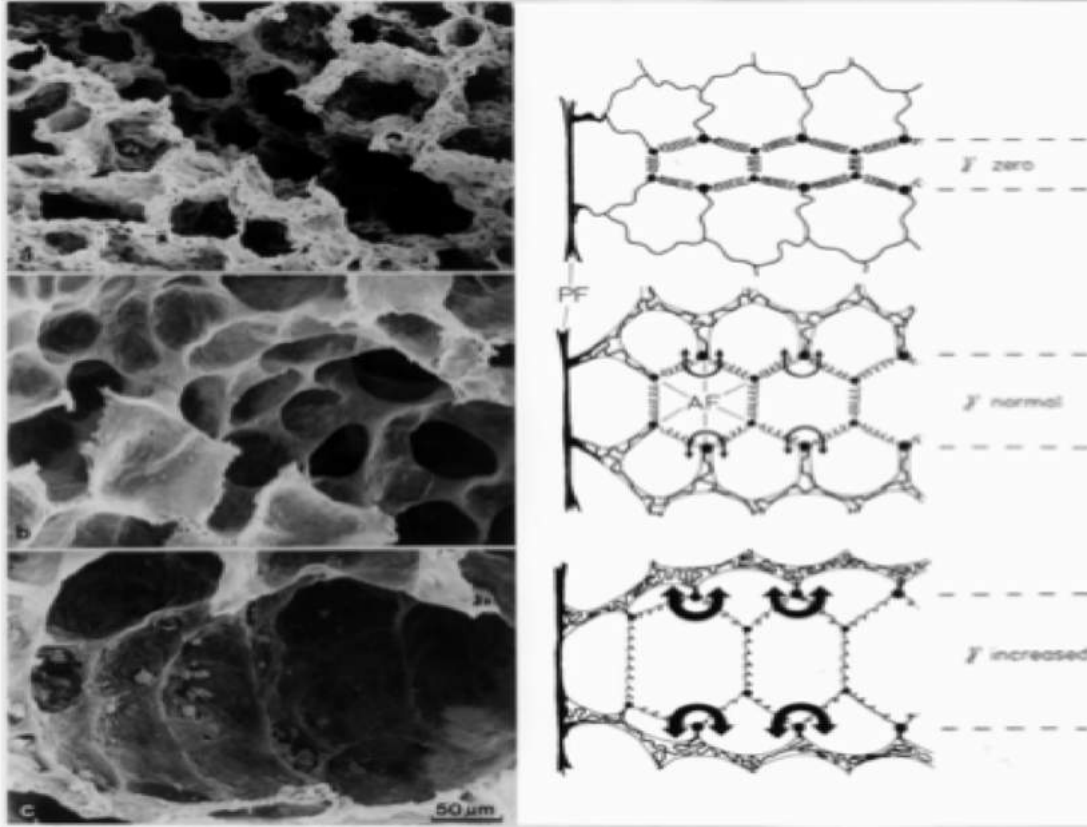
arrows = surface

lining layer ->

'surfactant'

Ep2 = type 2 cells

Erasmus MC

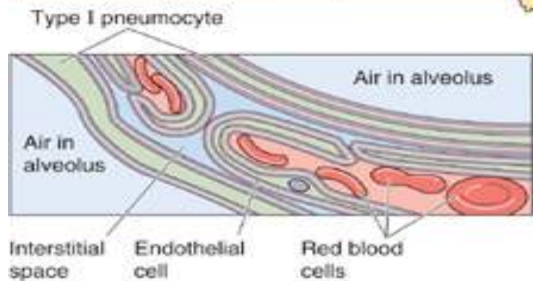
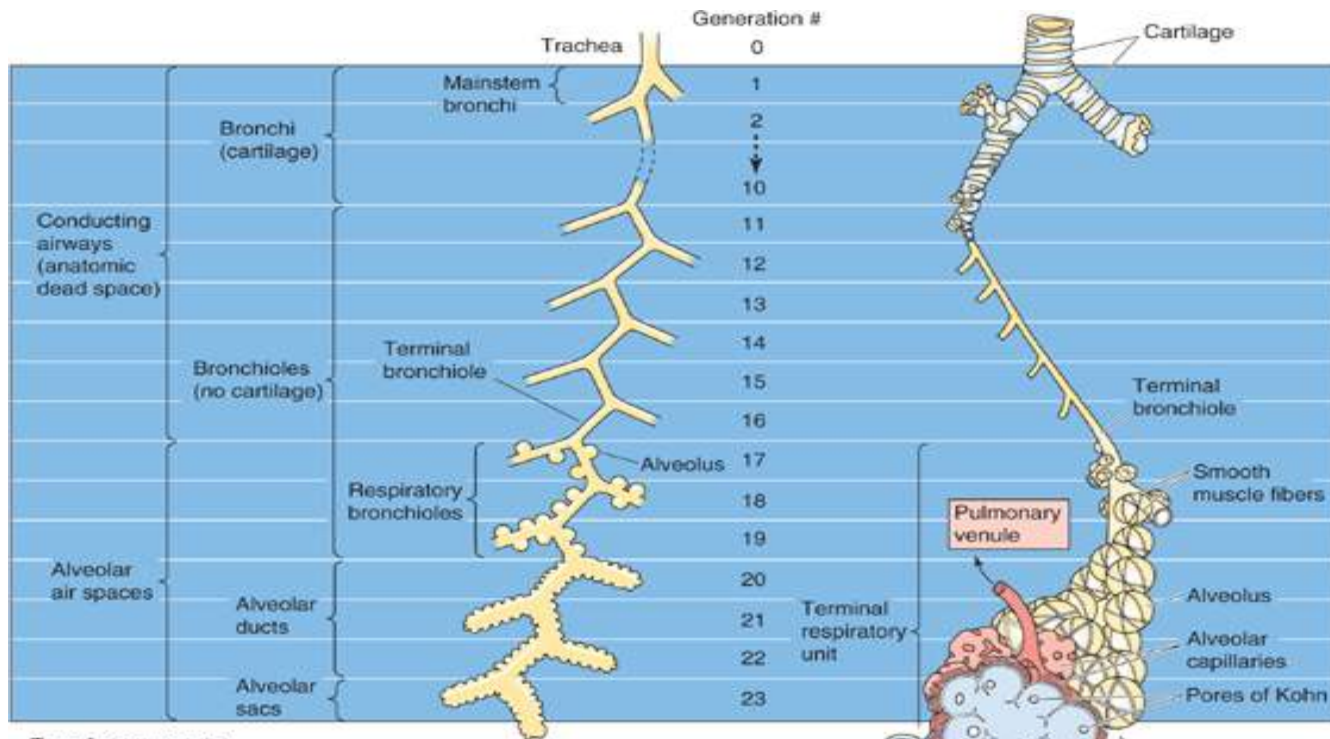


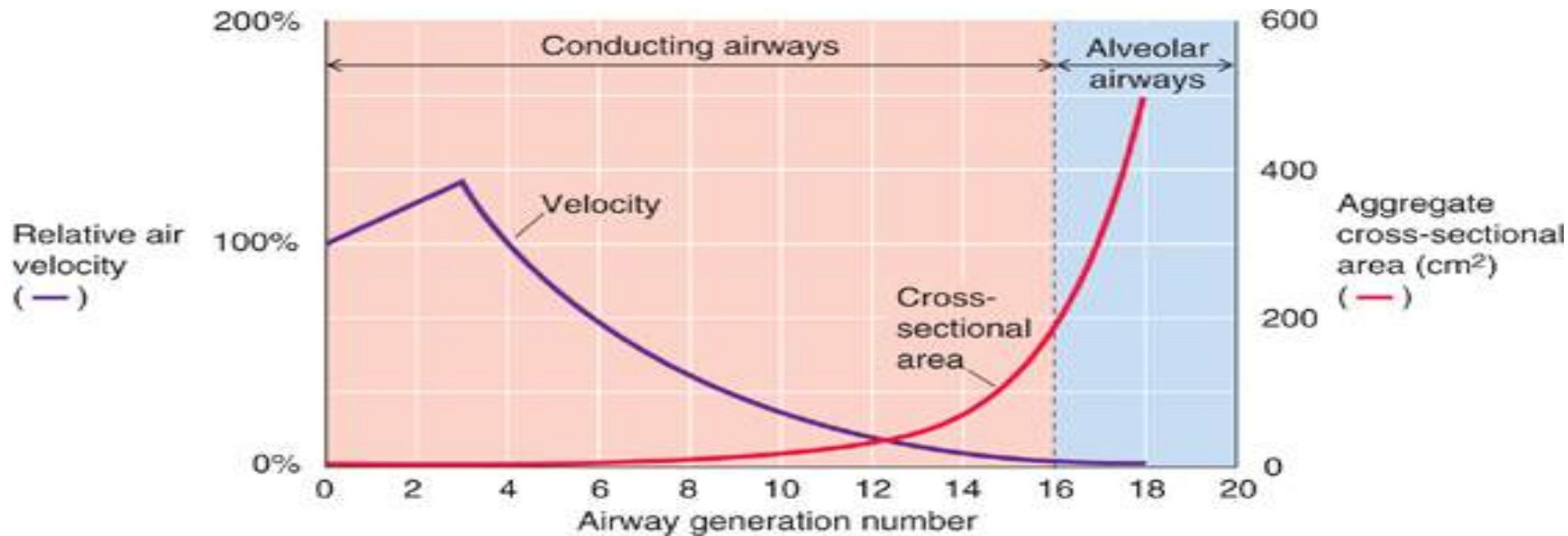
saline filled  
= small airways

air filled

detergent  
= large airways  
and small alveoli  
due to high  
surface tension

Erasmus MC





**Elastance** = mate van stijfheid

$$E_{RS} = E_L + E_{CW}$$

**Compliance** = mate van elasticiteit  
'the ability of the lung to  
stretch and expand'



# Compliance:

$$\Delta V / \Delta P$$

$$\text{mL/cmH}_2\text{O}$$

# Elastance:

$$\Delta P / \Delta V$$

cmH<sub>2</sub>O/mL

$$E_{rs} = E_L + E_{cw}$$

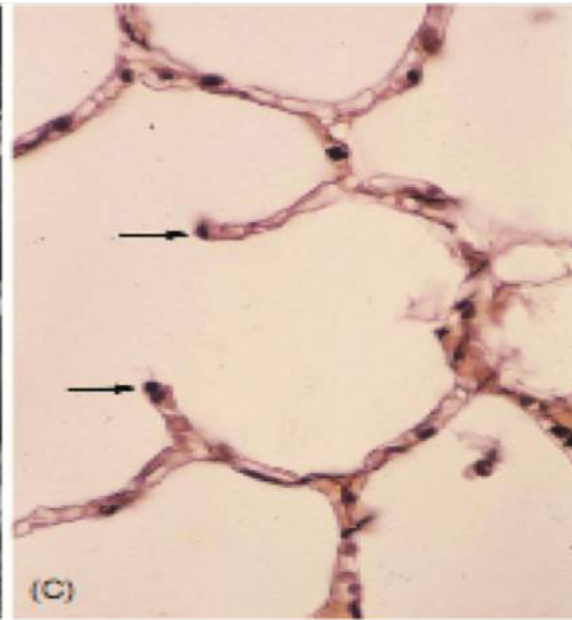
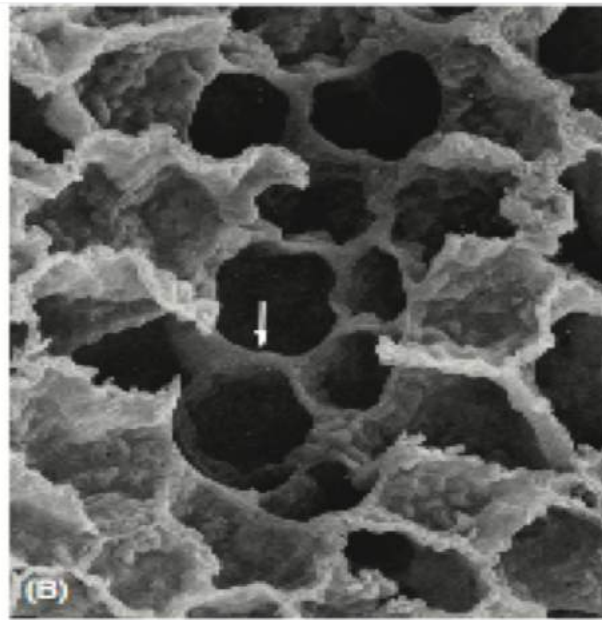
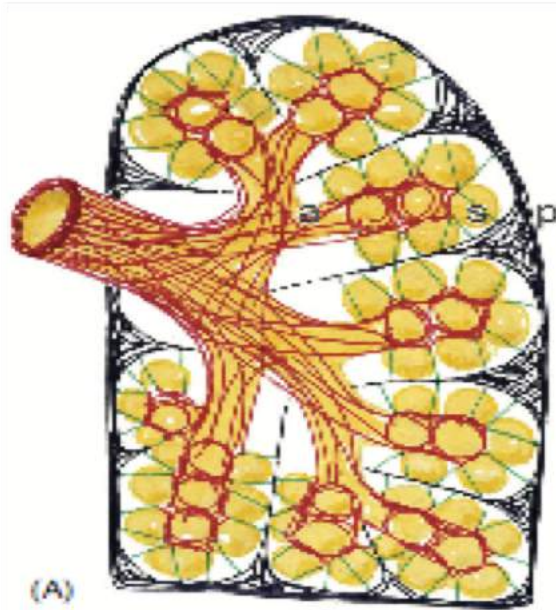
**Lung elastance  $E_L$ :**

$$E_L = P_{L-insp} - P_{L-exp} / Vt$$

$$E_L = (P_{plat} - P_{es-insp}) - (\text{total PEEP} - P_{es-exp}) / Vt$$

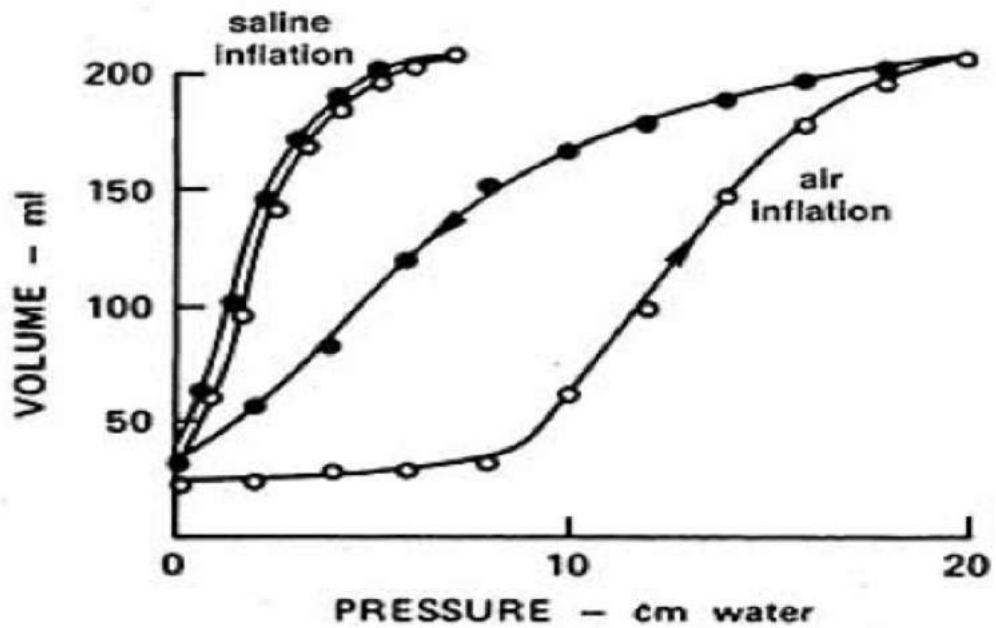
**Chest wall elastance  $E_{cw}$ :**

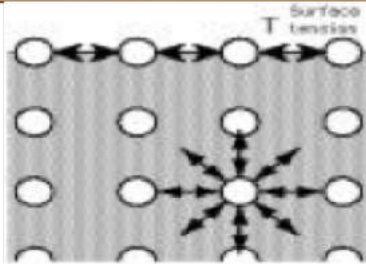
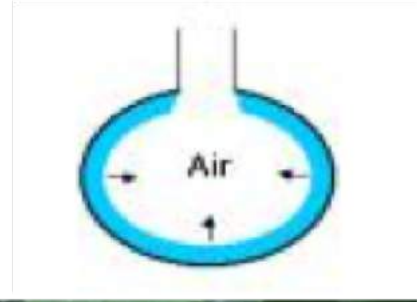
$$E_{cw} = P_{es-insp} - P_{es-exp} / Vt$$



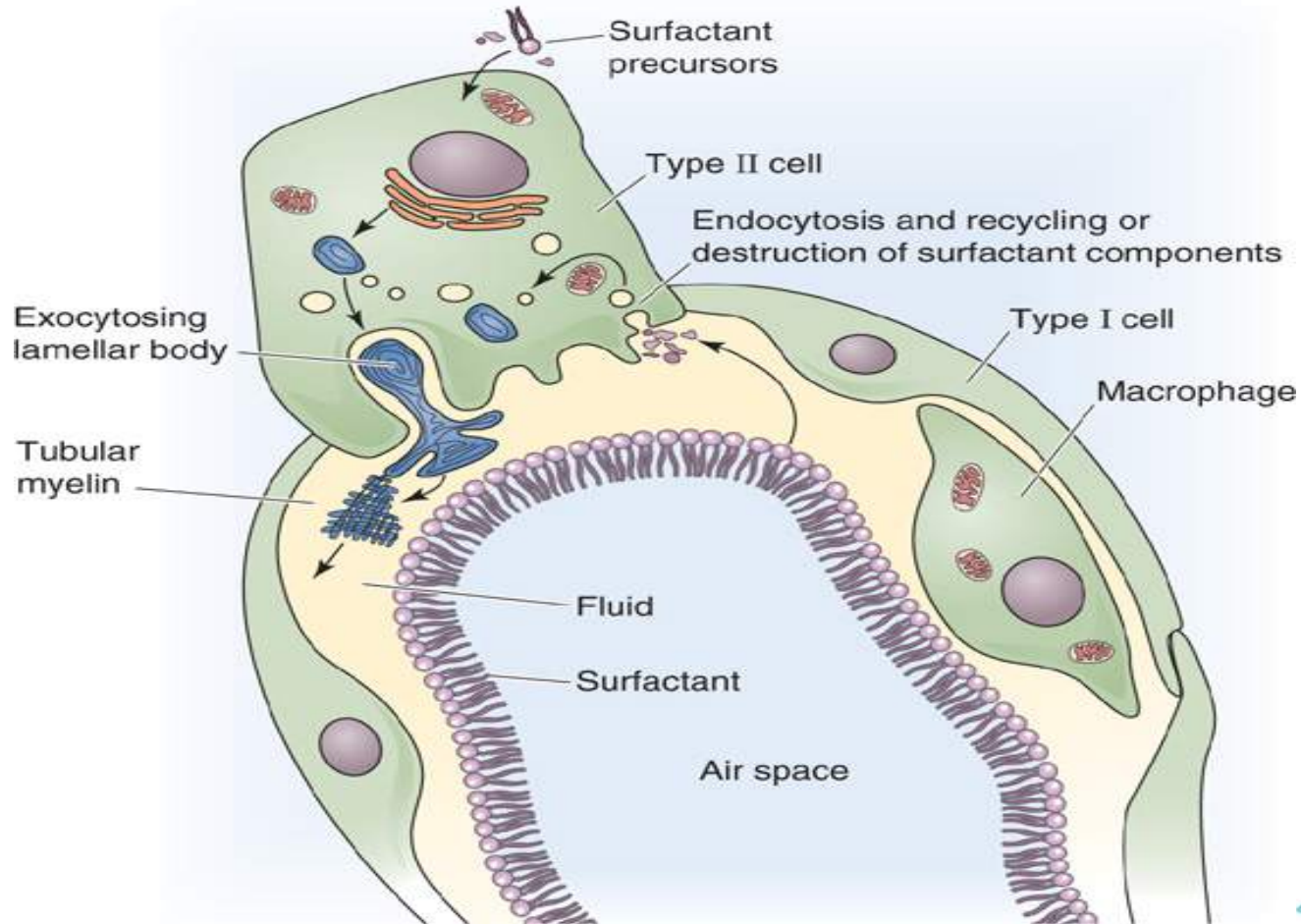
a = axial fiber (red)  
b = septal fiber (green)  
p = peripheral fiber (black)

arrow = axial fiber

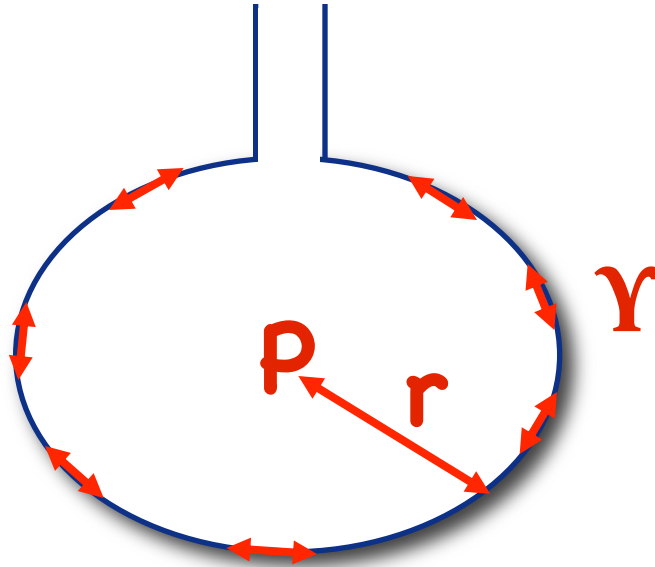




## A SURFACTANT METABOLISM



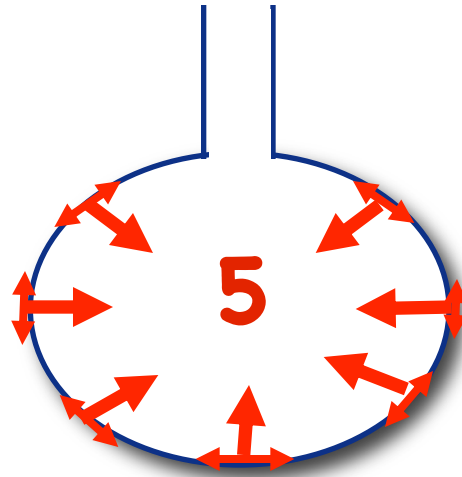
# Wet van LaPlace



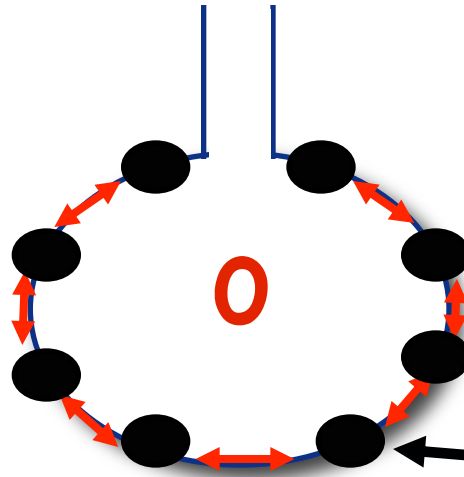
LaPlace:  $P = 2\gamma / r$



# Expiratie

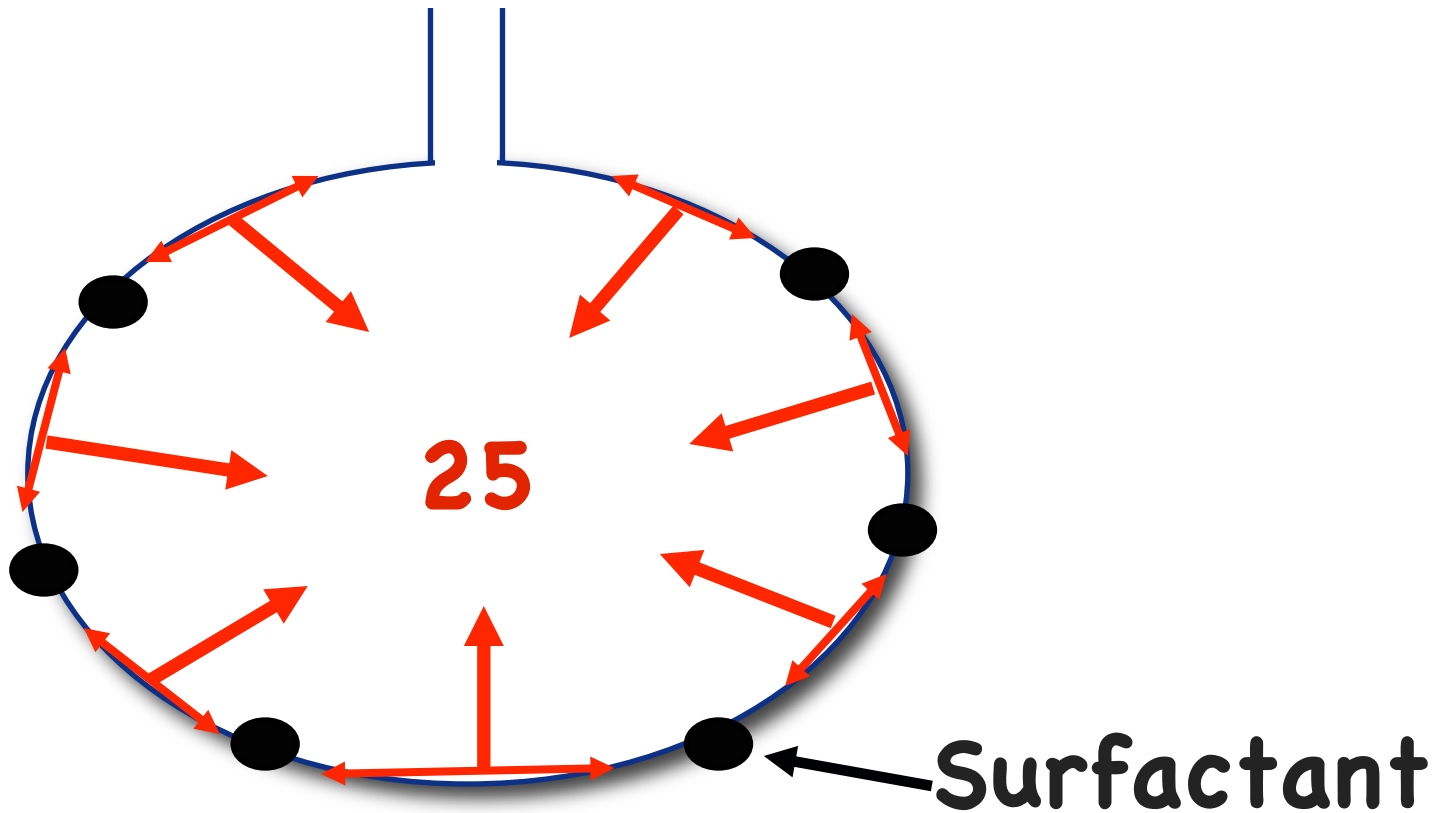


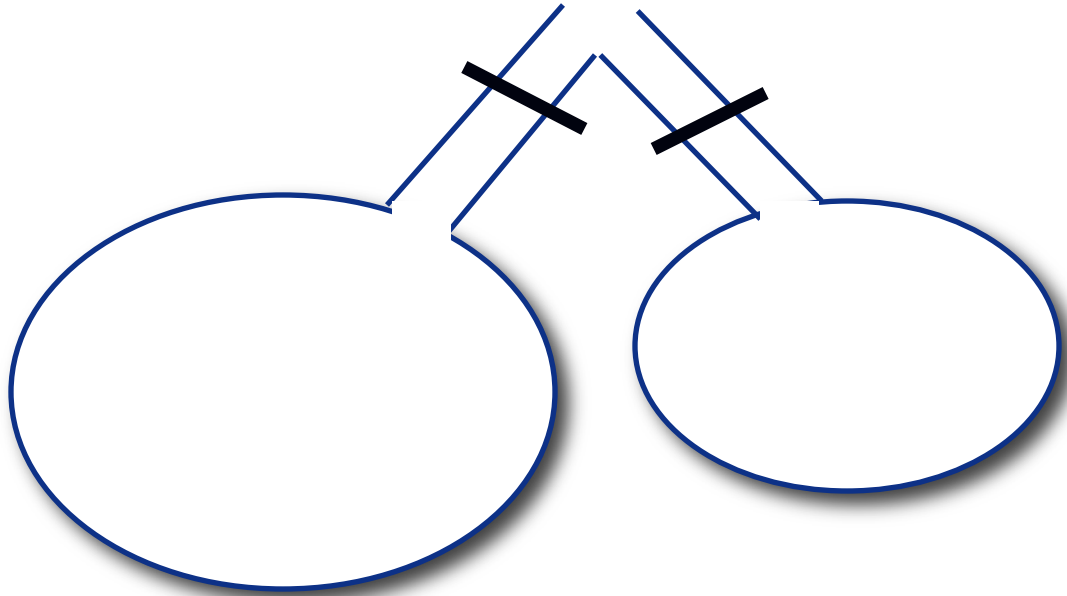
# Expiratie

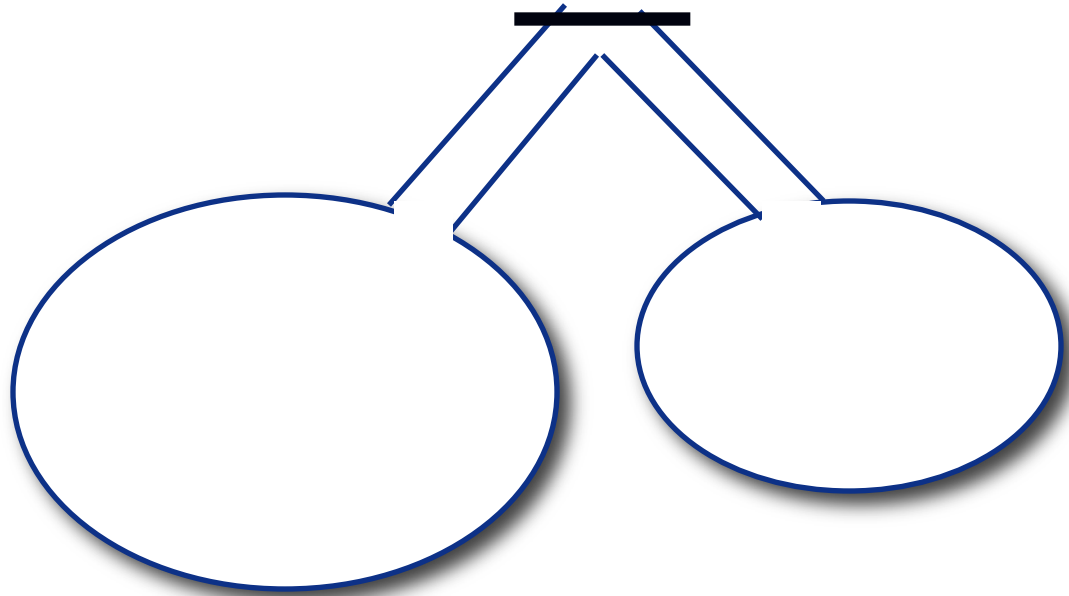


Surfactant

# Inspiratie



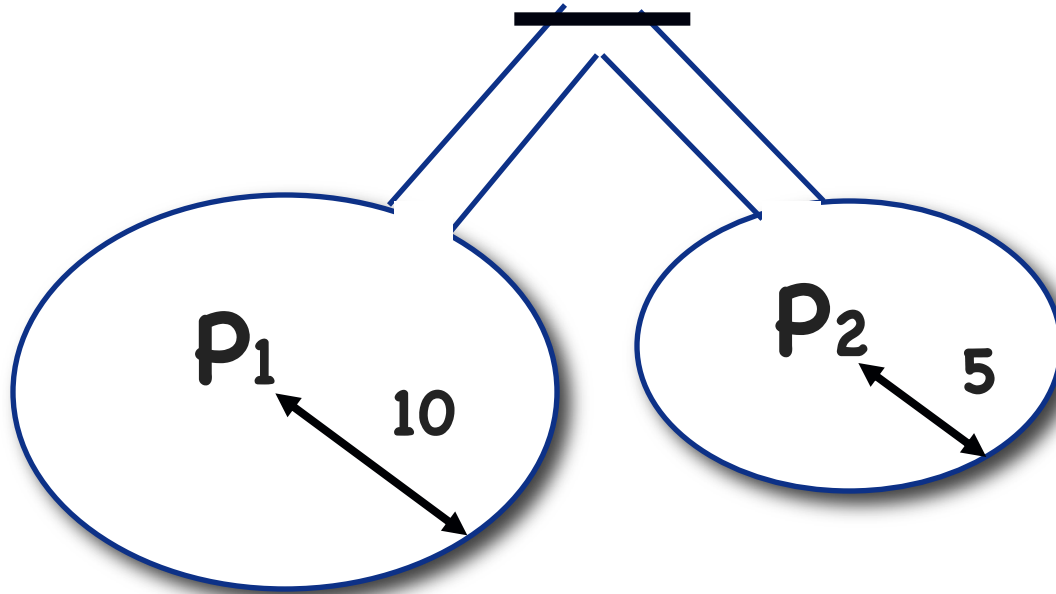




# Vraag:

1. worden beide even groot
  2. kleine loopt leeg
  3. grote loopt leeg
-

# Antwoord:



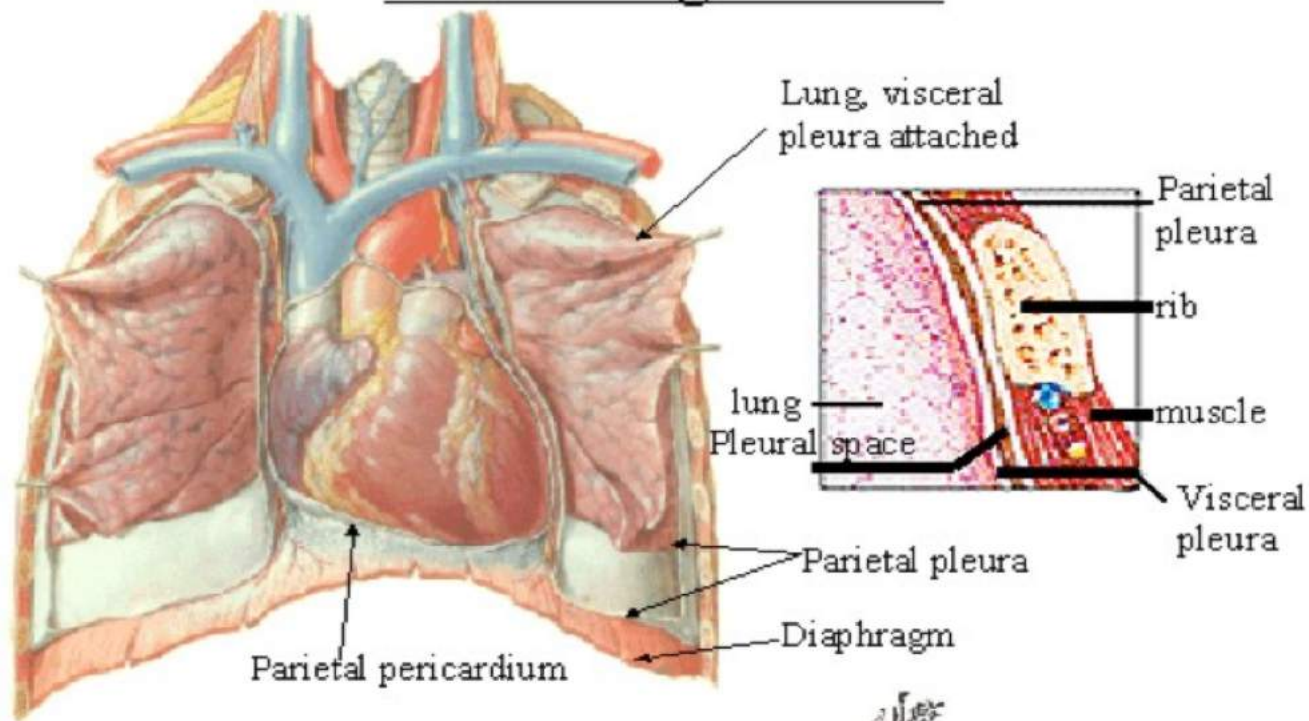
$$P_1 = 20/10 = 2$$

$$P_2 = 20/5 = 4$$

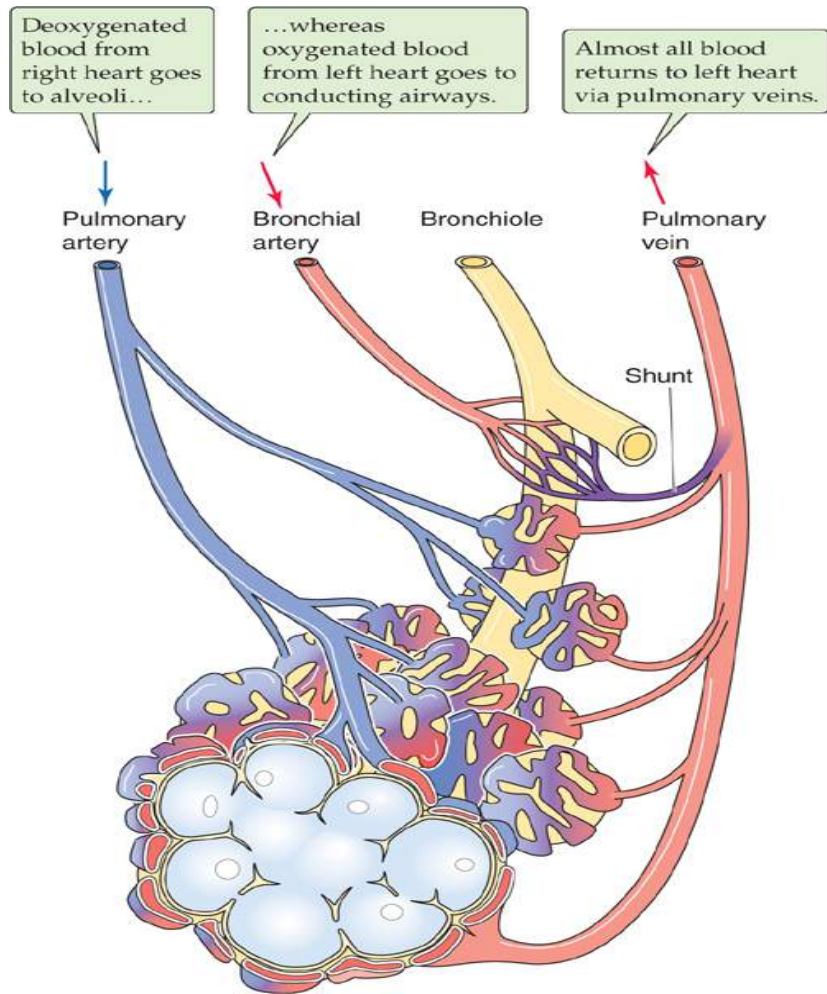
# Bloedvaten



## Heart-Lungs in Situ



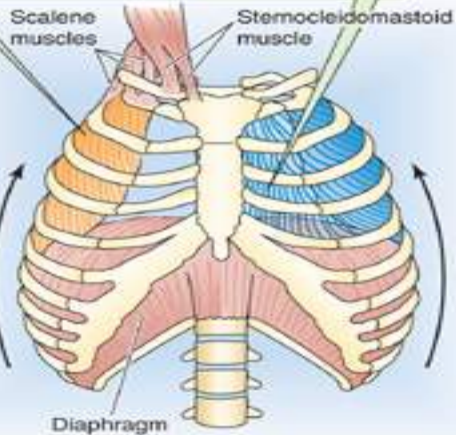
*W. J. J. J.*  
1814-1815



# Ademhalings spieren

**A INSPIRATION**

The most rostral and dorsal subsets of the **external** intercostal muscles (gold)—as well as the parasternal subset of the **internal** intercostal muscles (blue)—have an *inspiratory* mechanical advantage.

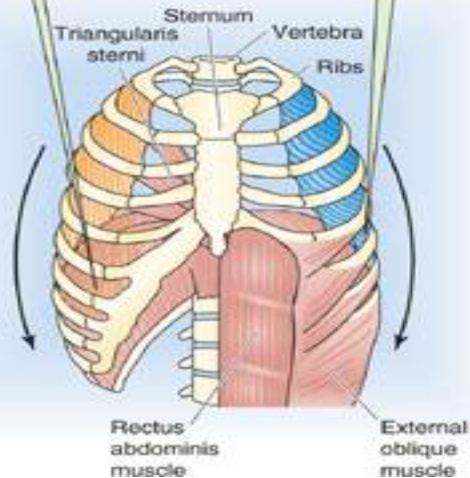


**B BUCKET-HANDLE AND WATER-PUMP-HANDLE EFFECTS**

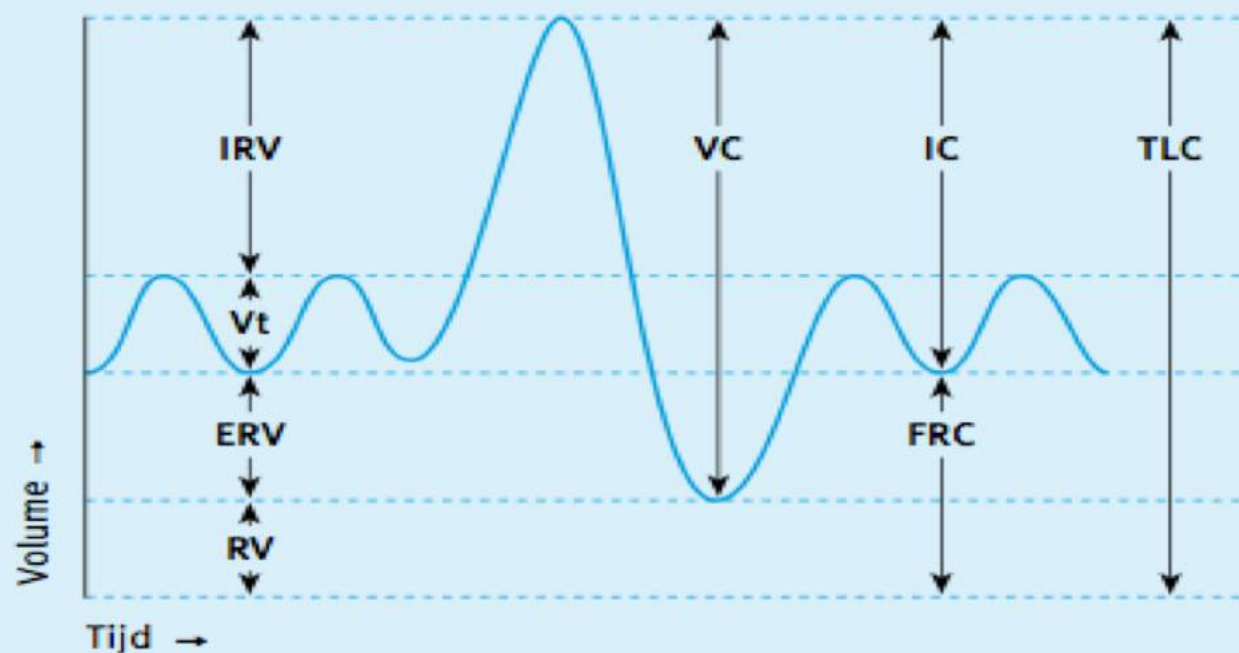


**C EXPIRATION**

The most caudal subset of the **internal** intercostal muscles (blue)—as well as the caudal-ventral subset of the **external** intercostal muscles (gold) and the triangularis sterni muscle (transversus thoracis)—have an *expiratory* mechanical advantage.

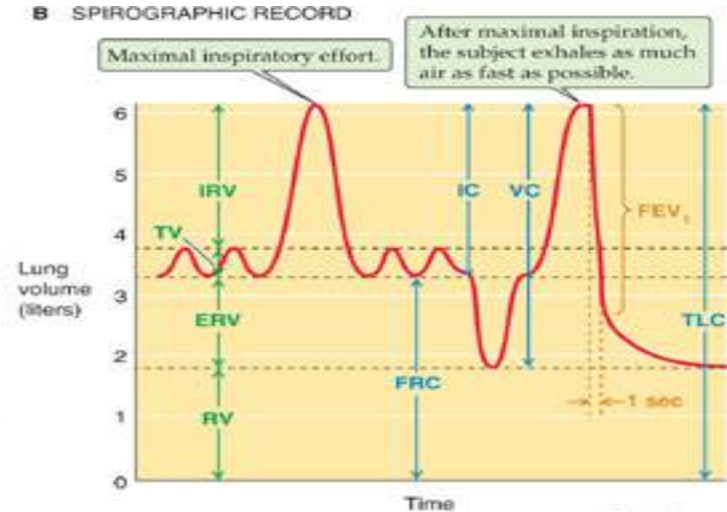
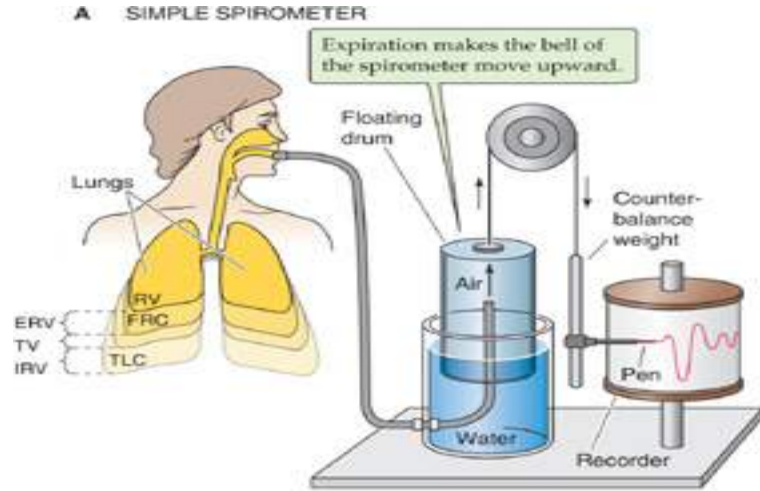


# Longvolumina



IRV = Inspiratoir reservevolume  
 Vt = Teugvolume  
 ERV = Expiratoir reservevolume  
 RV = Residuaal volume

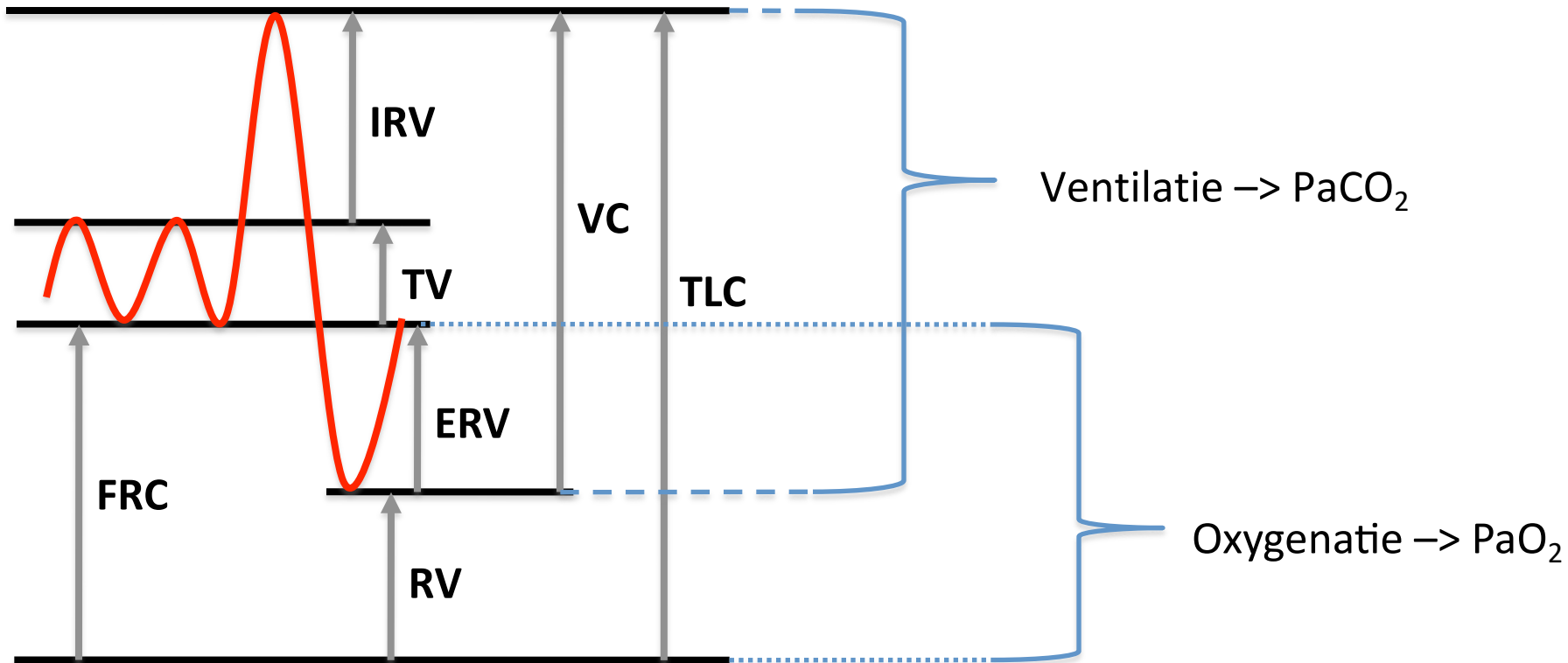
VC = Vitale capaciteit  
 IC = Inspiratoire capaciteit  
 FRC = Functionele residuale capaciteit  
 TLC = Totale longcapaciteit



Volume and Capacities	Typical ranges (liters)
IRV = Inspiratory reserve volume	1.9–2.5
TV = Tidal volume	0.4–0.5
ERV = Expiratory reserve volume	1.1–1.5
RV = Residual volume	1.5–1.9
TLC = Total lung capacity	4.9–6.4
IC = Inspiratory capacity	2.3–3.0
FRC = Functional residual capacity	2.6–3.4
VC = Vital capacity	3.4–4.5

FEV1 : voor het vaststellen van bronchoconstrictie  
 -> dus aangedaan bij astma

Restrictief longaandoeningen: afname van het  
 longvolume -> dus afname VC en FRC zoals een pneumonie



Normaal





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