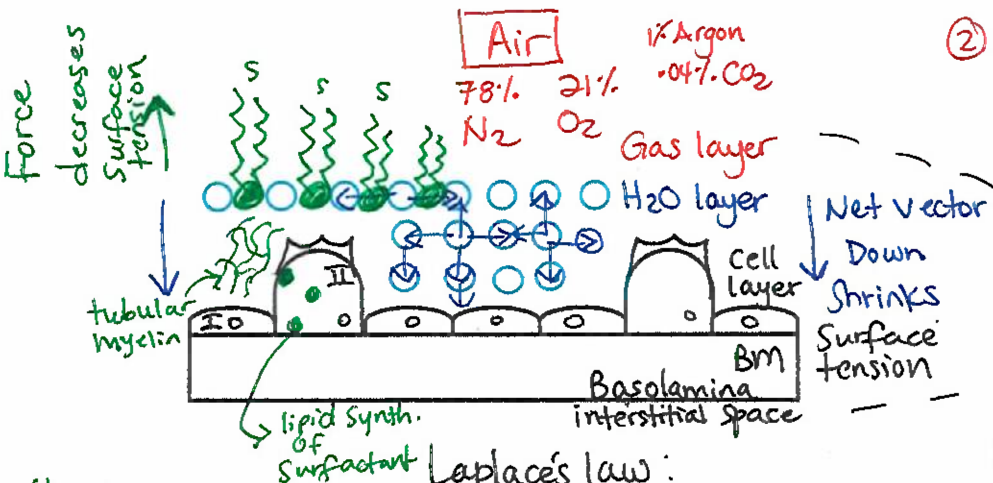
- Type I Alveolar Cells : Gas exchange, squamous epith. cells
- Type II Alveolar Cells : Surfactant, Cuboidal



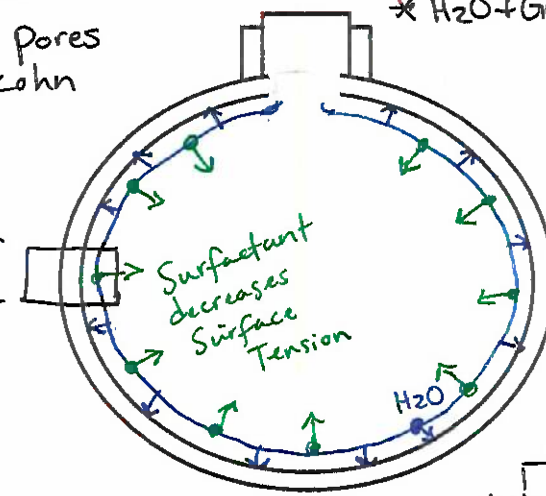
① Prevention of Surface Tension
* Surfactant

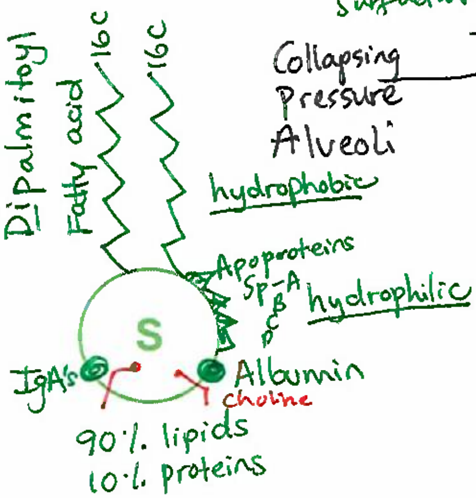
② Equilize pressure
* Alveolar Pores
Pores of Kohn

③ Improve Ventilation
* Constrict/Dilate Capillaries

Surface tension:

* Air-water interaction creates surface tension
* Collapsing of Alveoli
shrink Alveoli
* H_2O + Gas $\neq$ interact





Laplace's law:

Collapsing Pressure Alveoli $\longrightarrow P = \frac{2T \text{ (tension)}}{r \text{ (radius)}}$

$\uparrow T = \uparrow P$

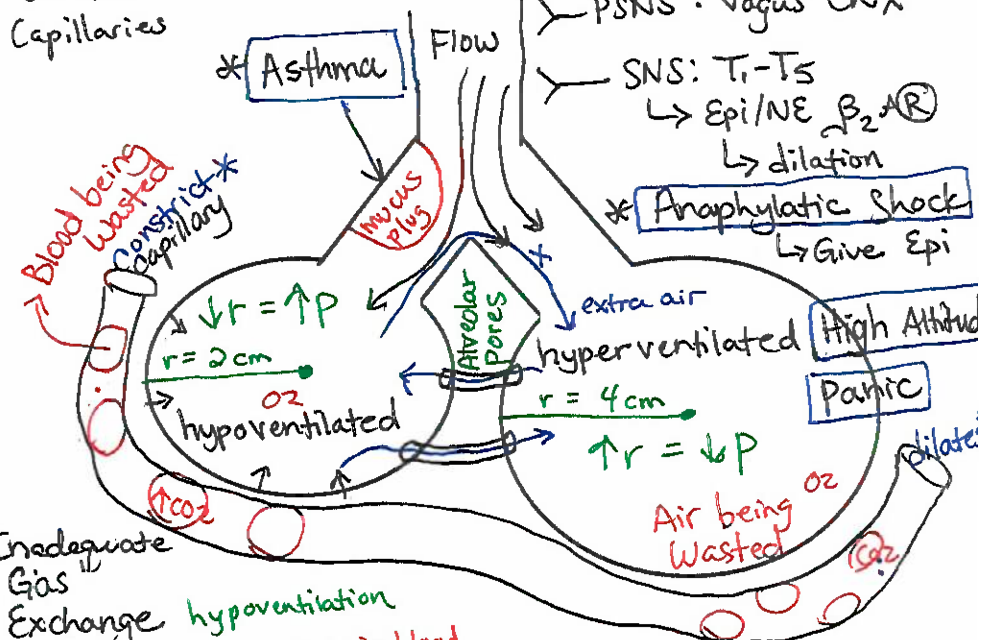
$\downarrow T = \downarrow P$

$\downarrow r = \uparrow P$

$\uparrow r = \downarrow P$

Pulmonary Edema

fluid/H_2O goes into interstitial space
O_2/CO_2 exchange



- PSNS : Vagus CN X
  - → Ach M_3 musc. Ⓡ
  - → constriction
- SNS: T_1–T_5
  - ↳ Epi/NE β_2 AⓇ
  - ↳ dilation

* Anaphylatic Shock
↳ Give Epi

High Altitude

Panic

Inadequate Gas Exchange
↓
Hypoxia

hypoventilation
CO_2 accum in blood

* COPD
* Respiratory Acidosis

$\uparrow CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$
$\uparrow$ acidity

$\downarrow CO_2$ in blood
Respiratory Alkalosis
hyperventilation

Pregnancy + Surfactant:

24th wk Gestation
Slow production
↓
fast ↑ production
34th wk Gestation

↑ cortisol makes Surfactant

" Outside the body
around us "

$P_{Atmospheric}$ 760mmHg

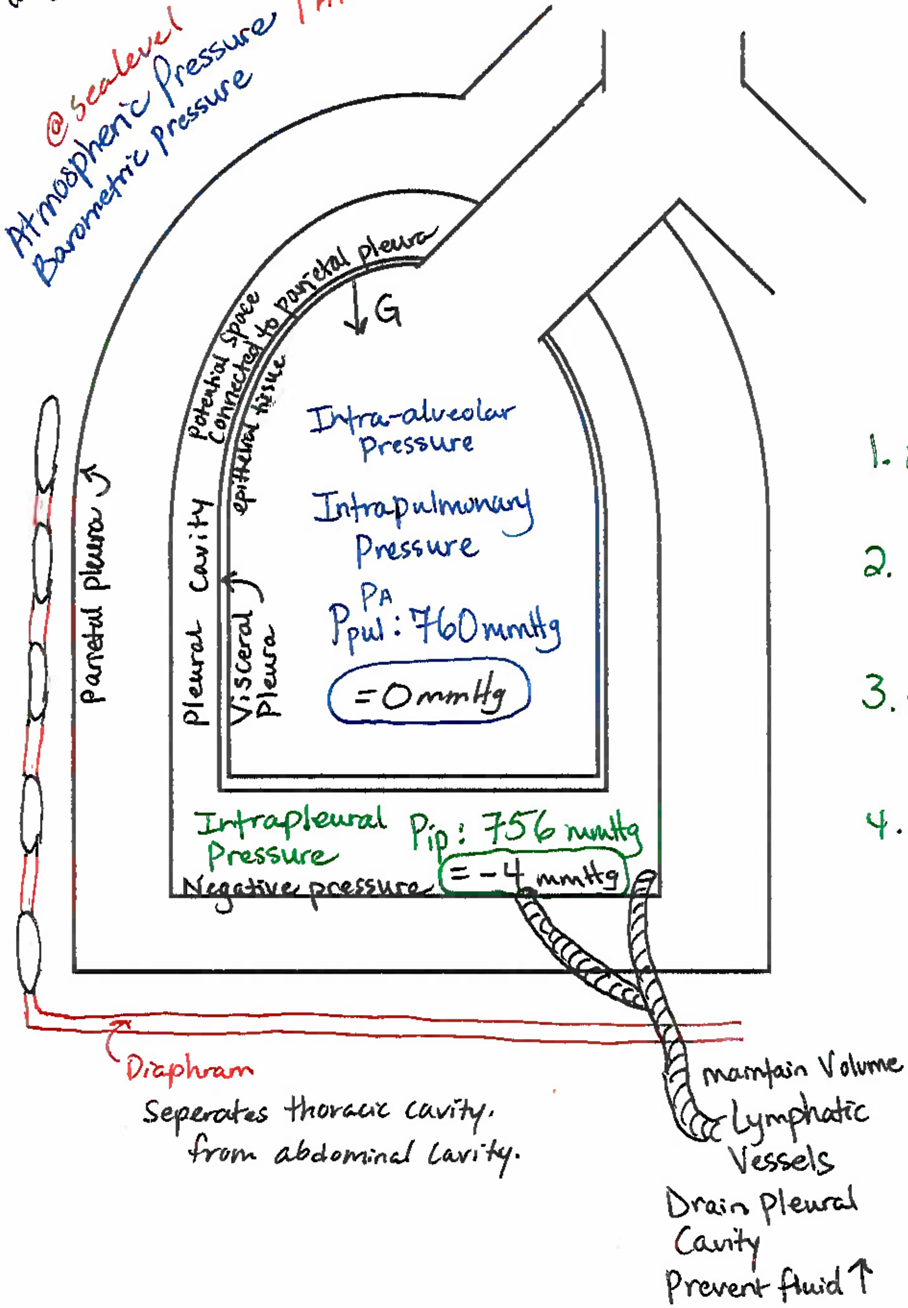
@ sealevel
Atmospheric Pressure P_{ATM}
Barometric pressure

∴ number minus P_{ATM}.

* Rule: when we compare pressures, we always compare it to the Atmospheric pressure.

P_{ip} becomes (+) $\boxed{\text{pneumothorax}}$
lung collapses

- Intrapulmonary Pressure (intra-alveolar) = P_A or P_{pul} 760 mmHg
  $760 - 760 = 0$ = to atmospheric pressure
- Intrapleural Pressure = P_{ip} 756 mmHg
  $756 - 760 = -4$ mmHg
- Atmospheric Pressure = P_{atm} 760 mmHg



Intrapleural Pressure Pip

1. * elasticity of lungs: deflate pull visceral away from parietal pleura
   doesn't want to stretch
   wants to recoil
   Pull in
2. * Surface tension: collapse lungs
   air-water interface
   Collapse visceral pleura
   Pull in
3. * elasticity of chest wall: expand chest wall
   Pull chest wall out
   elastic/connective tissue chest wall
4. Gravity:
   differences in pressures

↑ Thoracic Cavity Volume
= P_{ip} space = −4 mmHg
maintain Negative Pressure

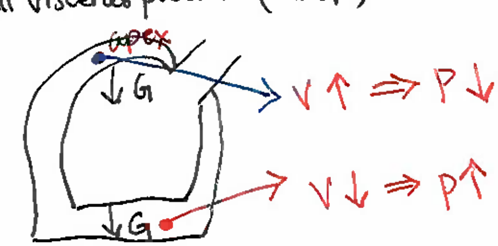
∴ ↑ volume ⇒ ↓ pressure

Boyle's Law

- $P_1V_1 = P_2V_2$
- ↑P = ↓V
- ↓P = ↑V

∴ Pip: not uniform thru entire pleural cavity.

* Gravity:
- pull down on the bottom of the lung → pulls the apex away
- pull visceral pleura (↓G)



Forced inspiration

Pip @ −7mmHg
PA @ −2mmHg

"Quiet" Inspiration:

Air flows in
∴ high → low pressure

Pip = Intrapleural Pressure
Pip @ rest = −4 mmHg
Pip @ inspiration = −6mmHg
PA @ rest = 0 mmHg
PA @ inspiration = −1 mmHg (759 mmHg)
Patm = 0 mmHg (760 mmHg)
"same"

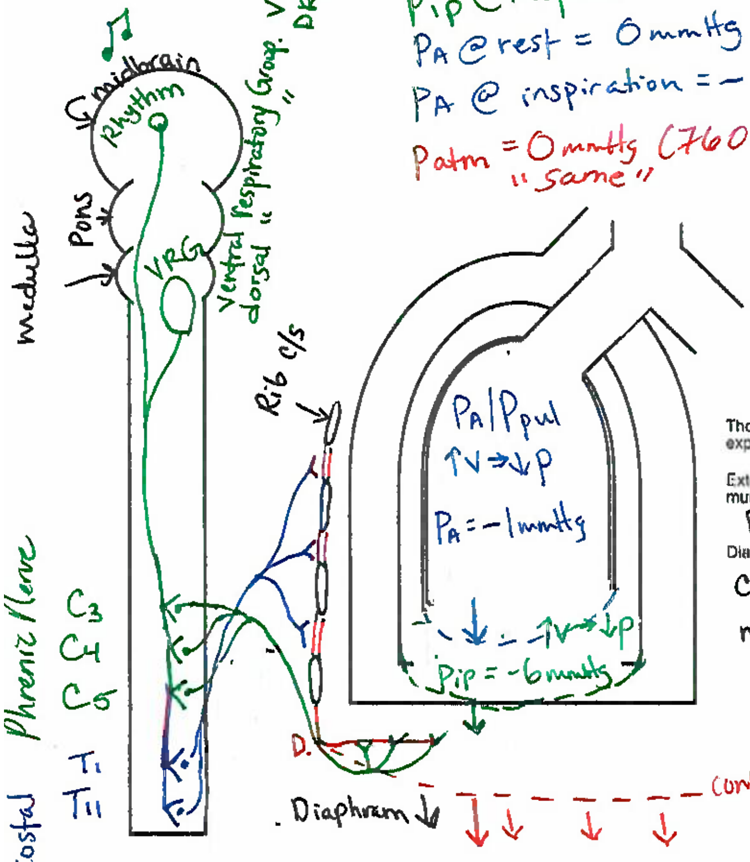
Forced Expiratory

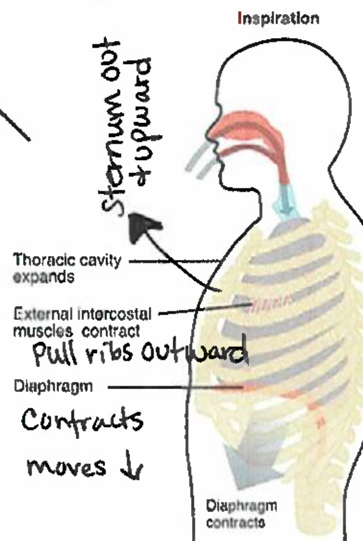
Pip @ −3mmHg
PA @ +2mmHg

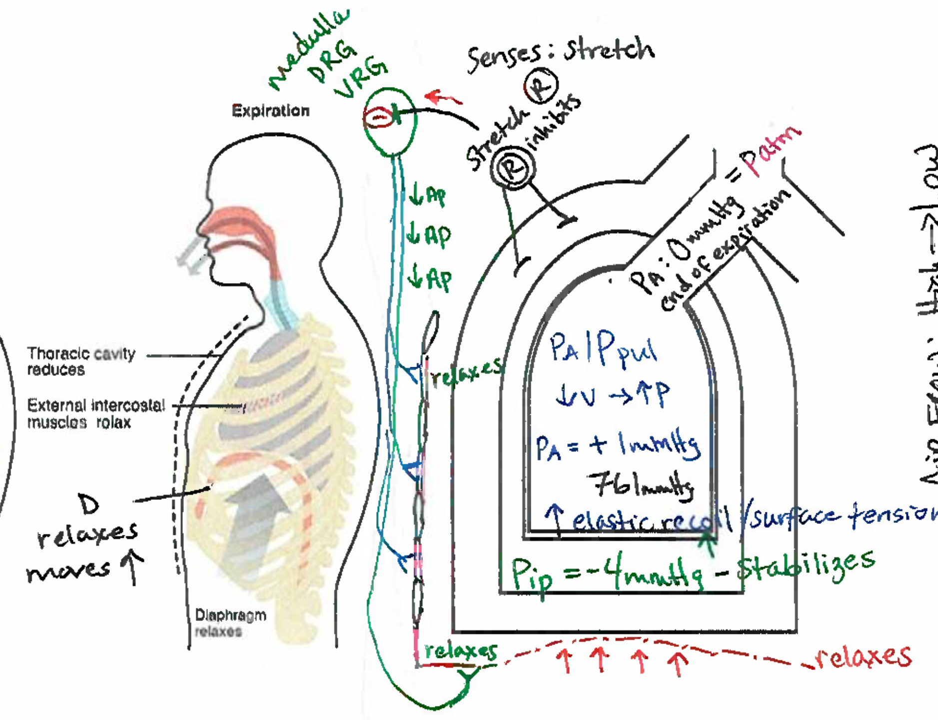
"Quiet" Expiration:

- no m/s involved (shut down neural pth)
- depends on ElASTICITY of lungs

$E = \frac{\Delta P}{\Delta V}$ ↑E → ↓V
elastic recoil







* Quiet inspiration *

1. external intercostals + Diaphram Contract
2. ↑ thoracic cavity volume (Pip)
   ↑V ⇒ ↓P
   Pip : ↓ pressure
   PA : ↓ pressure

"Forced" Inspiration

- * Sternocleido-mastoid (SCM)
- * Scalenes : 1st 2 Ribs
- * pectoralis minor
  elevates ribs 3-5

"Forced" Expiration

- * Abdominal Wall m/s
  - external oblique
  - Internal Oblique
  - Transverse Abdominis
  - Rectus Abdominis

  Pushes ON Diaphram

  Diaphragm ↑ ↑ ↑ m/s

- * Internal Intercostals
  Pulls ribs ↓ push sternum in
  ↓ volume
  ↓ thoracic cavity Volume

* Quiet Expiration *

1. no m/s; d/t ↓ AP's ⇒ relax
2. ↓ Thoracic Volume (Pip)
   ↓V → ↑P