

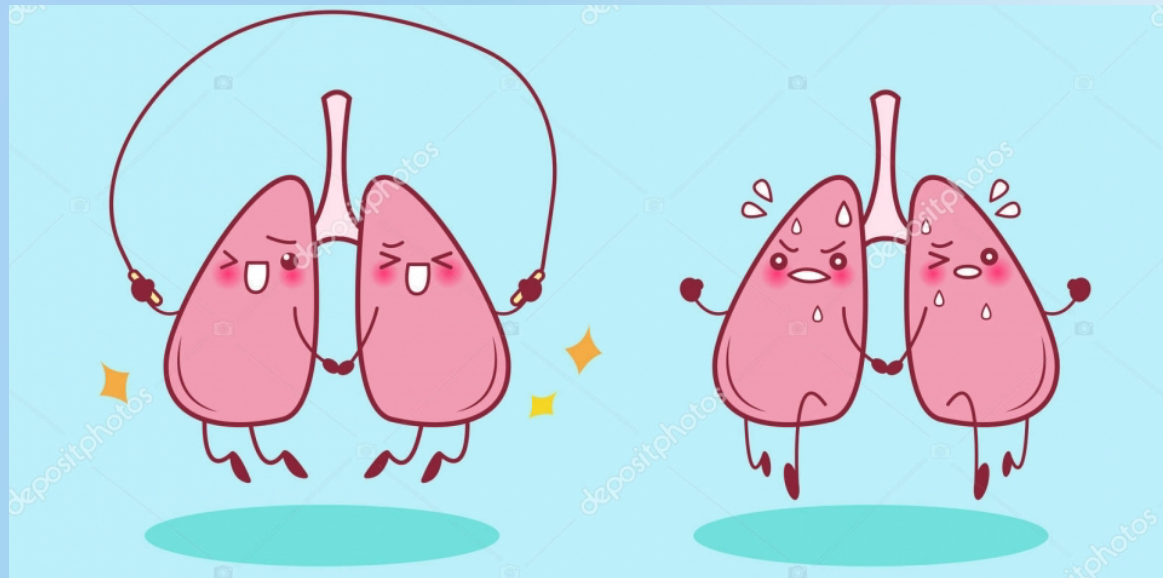
Integrative functions

Alexandra Vedeler

You're at the gym



What is happening to your respiratory system?



Hyperpnea

– increase in depth and/or respiratory rate without changing *arterial* blood chemistry



Increased oxygen demand

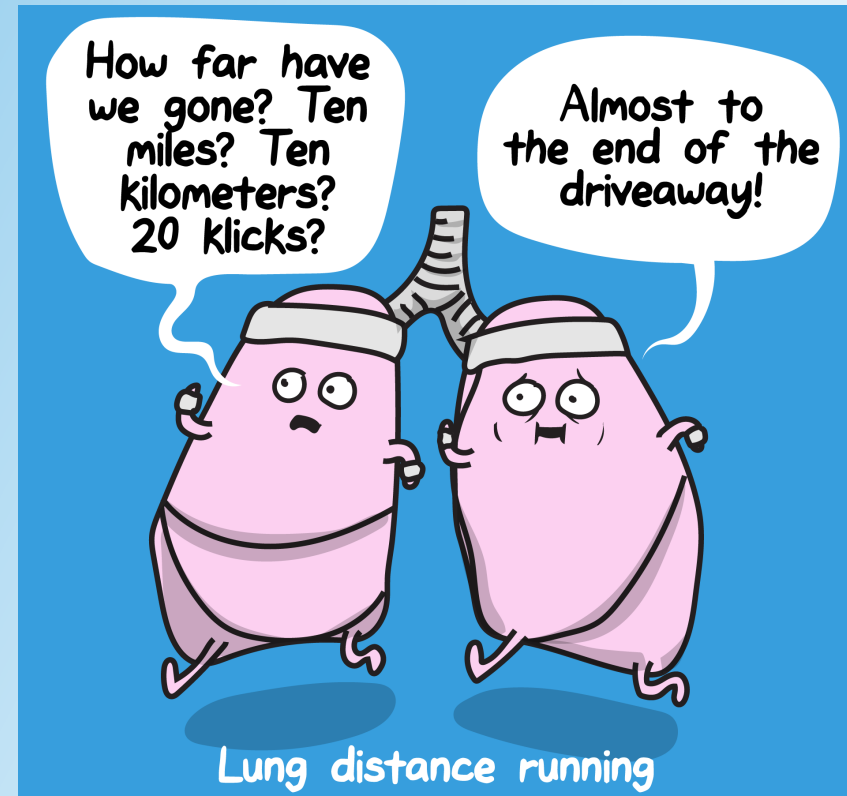
- Increased muscle work
- Increased demand of ATP
- Increased demand of oxygen

- Anaerobic exercise
 - Lactic acid production
 - Decreased pH
 - Stimulation of carotid bodies



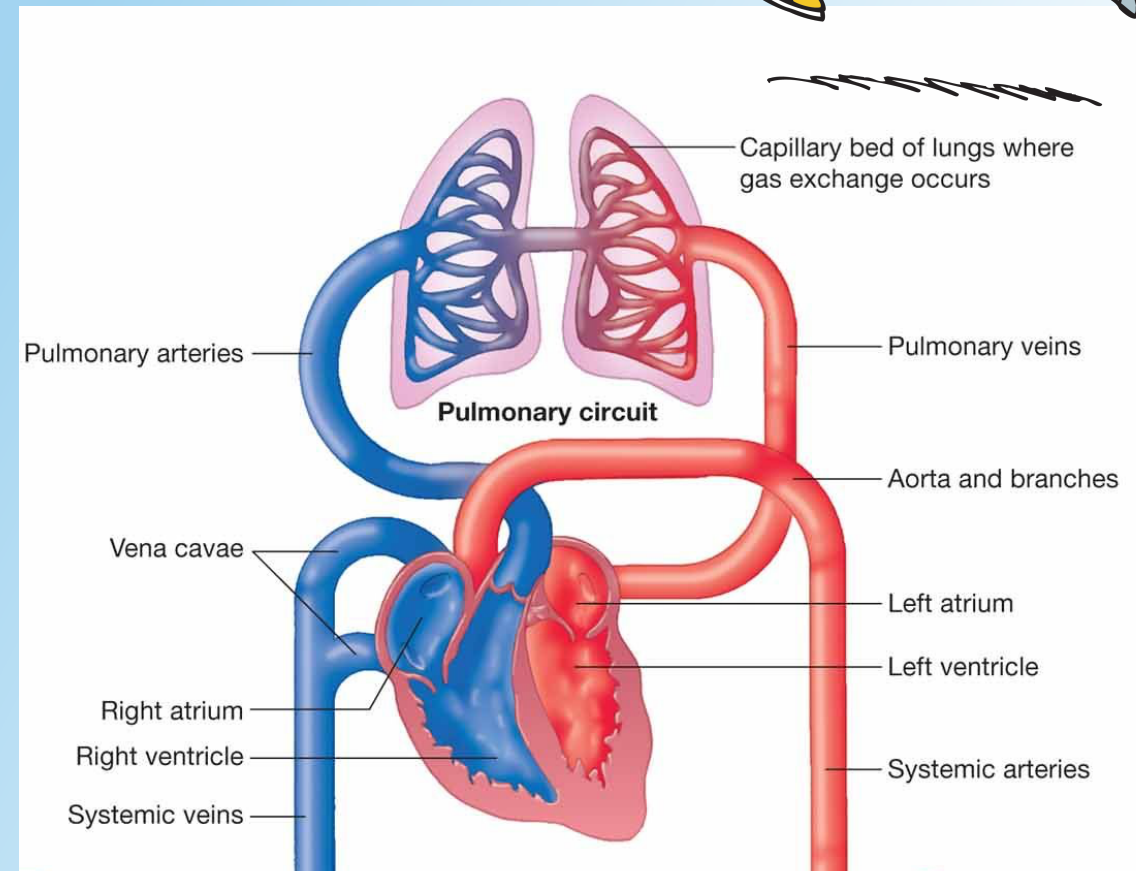
Increased ventilation

- Muscle-joint receptors stimulate the DRG
- Voluntary breathing
- Activation of expiratory center

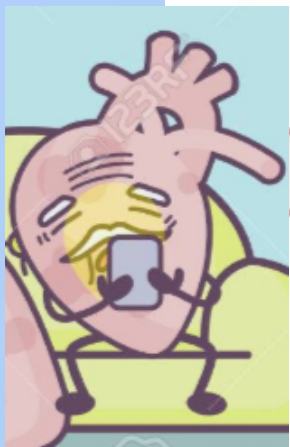
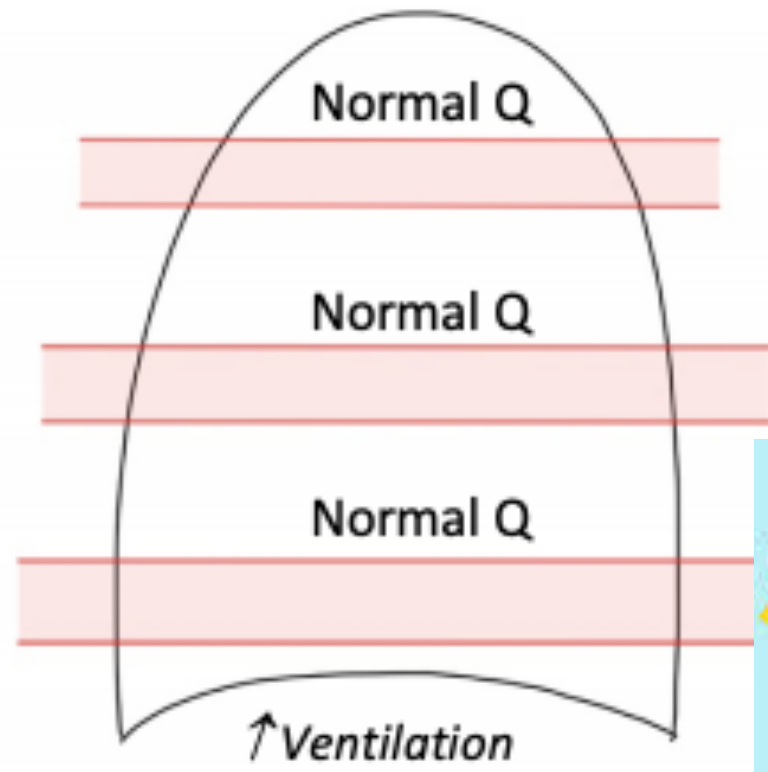
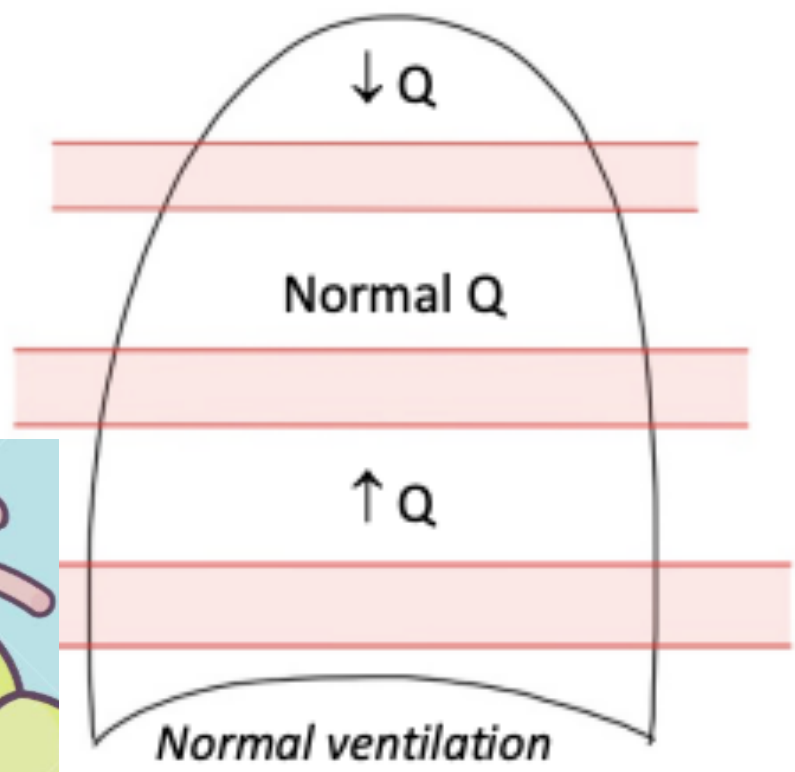


Increased cardiac output

- Up to 6x normal cardiac output
- Increased blood volume from **right ventricle** and left ventricle
- Increased perfusion of the lung



\uparrow Ventilation + \uparrow perfusion = \uparrow gas exchange



Gas exchange at tissue site

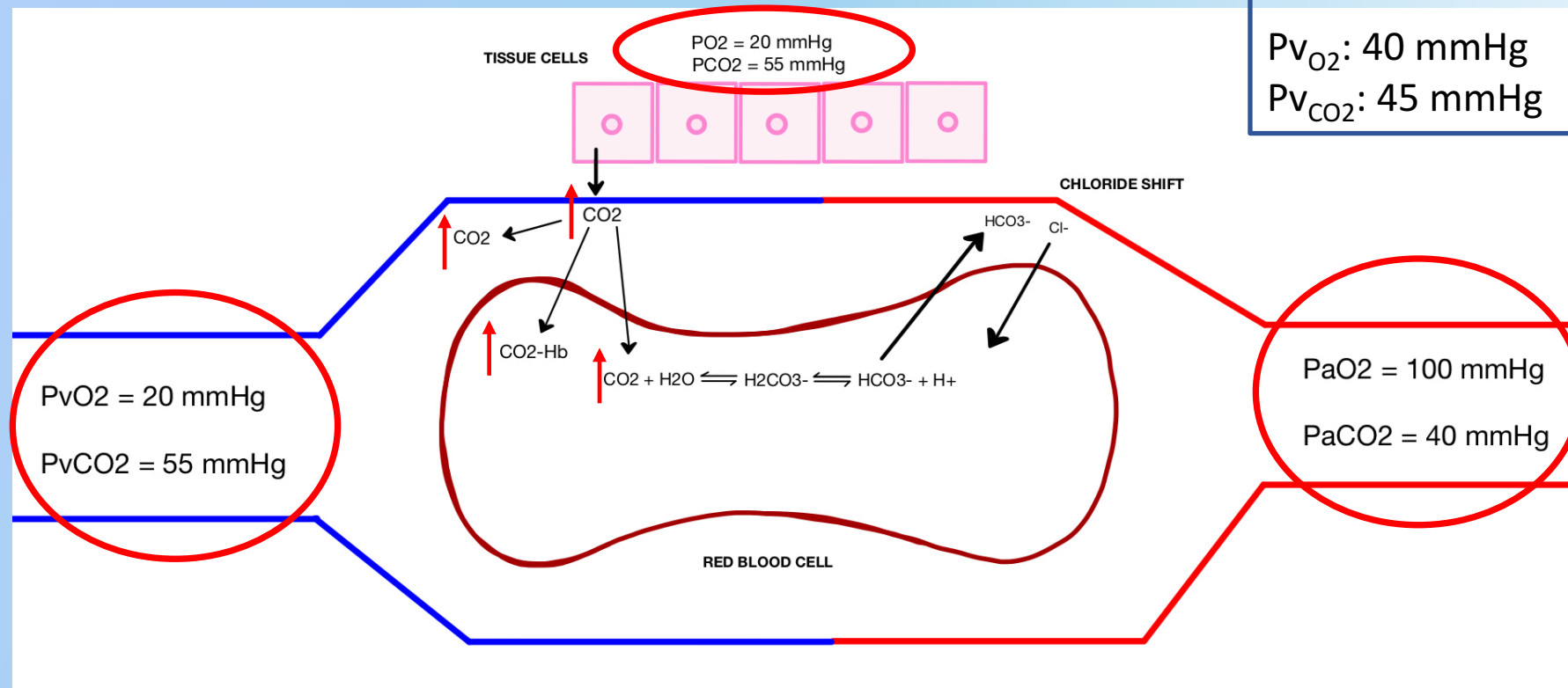
Normal values

P_{aO_2} : 100 mmHg

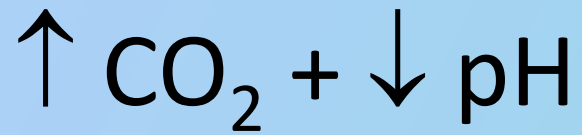
P_{aCO_2} : 40 mmHg

P_{vO_2} : 40 mmHg

P_{vCO_2} : 45 mmHg



Bohr effect



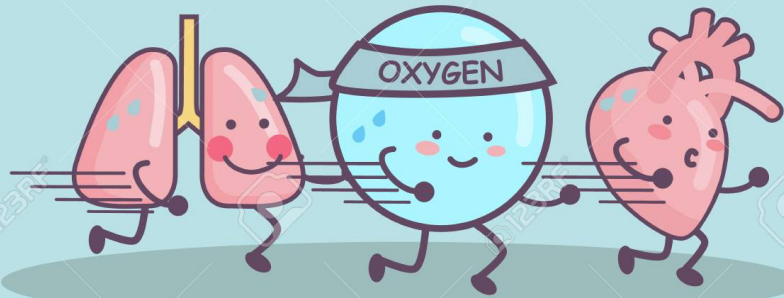
- Exercise and $\text{CO}_2 \rightarrow$ increased venous, Hb, and RBC CO_2
- Increased venous $\text{CO}_2 \rightarrow$ decreased pH
- The effect on hemoglobin \rightarrow **decreased oxygen affinity and increased oxygen-delivery to tissues**

2,3 BPG

- The red blood cells produce more 2,3 BPG
- Decreases affinity of hemoglobin to oxygen
- Increases oxygen-delivery to tissues



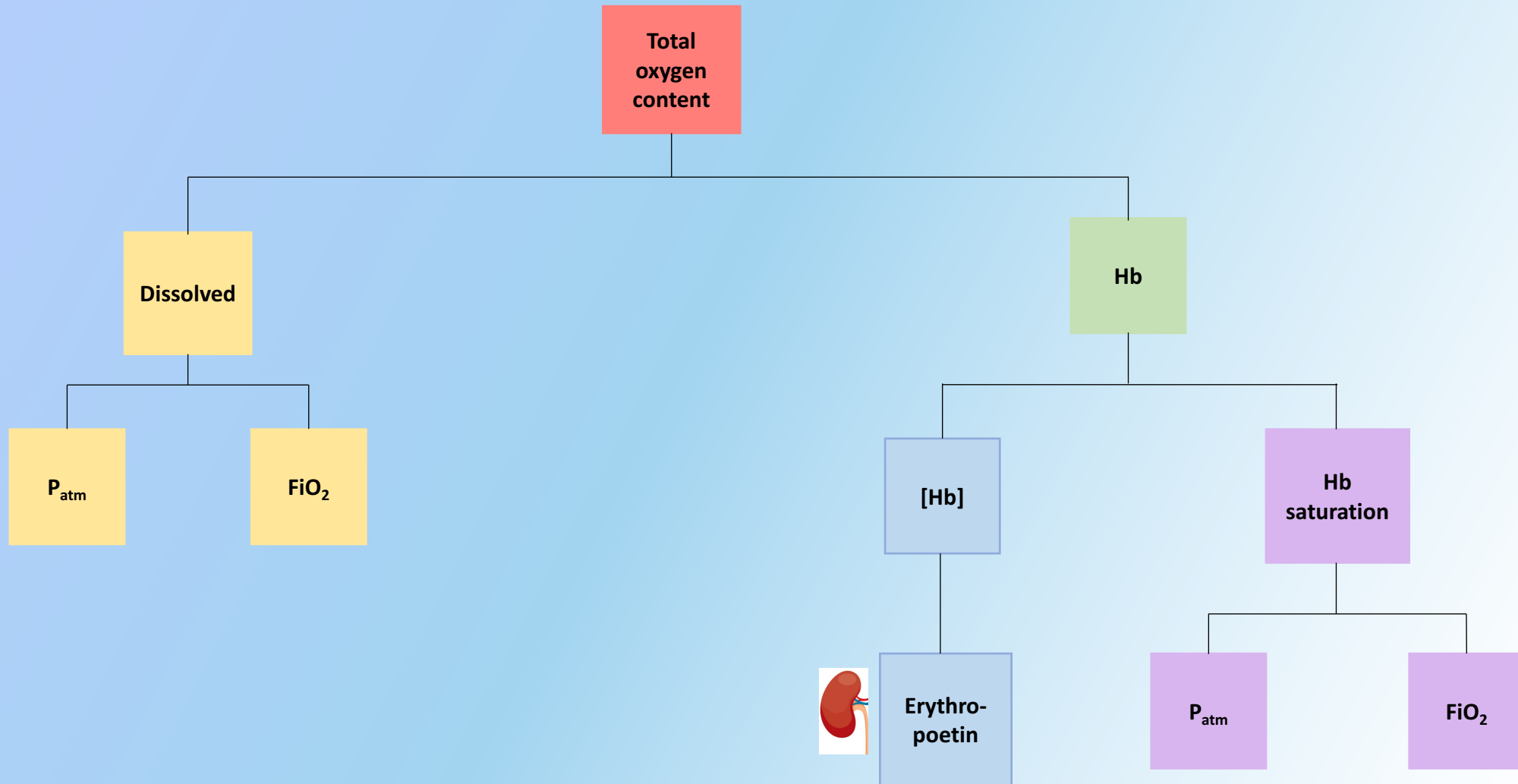
No pain no gain



Let's climb Mt. Everest



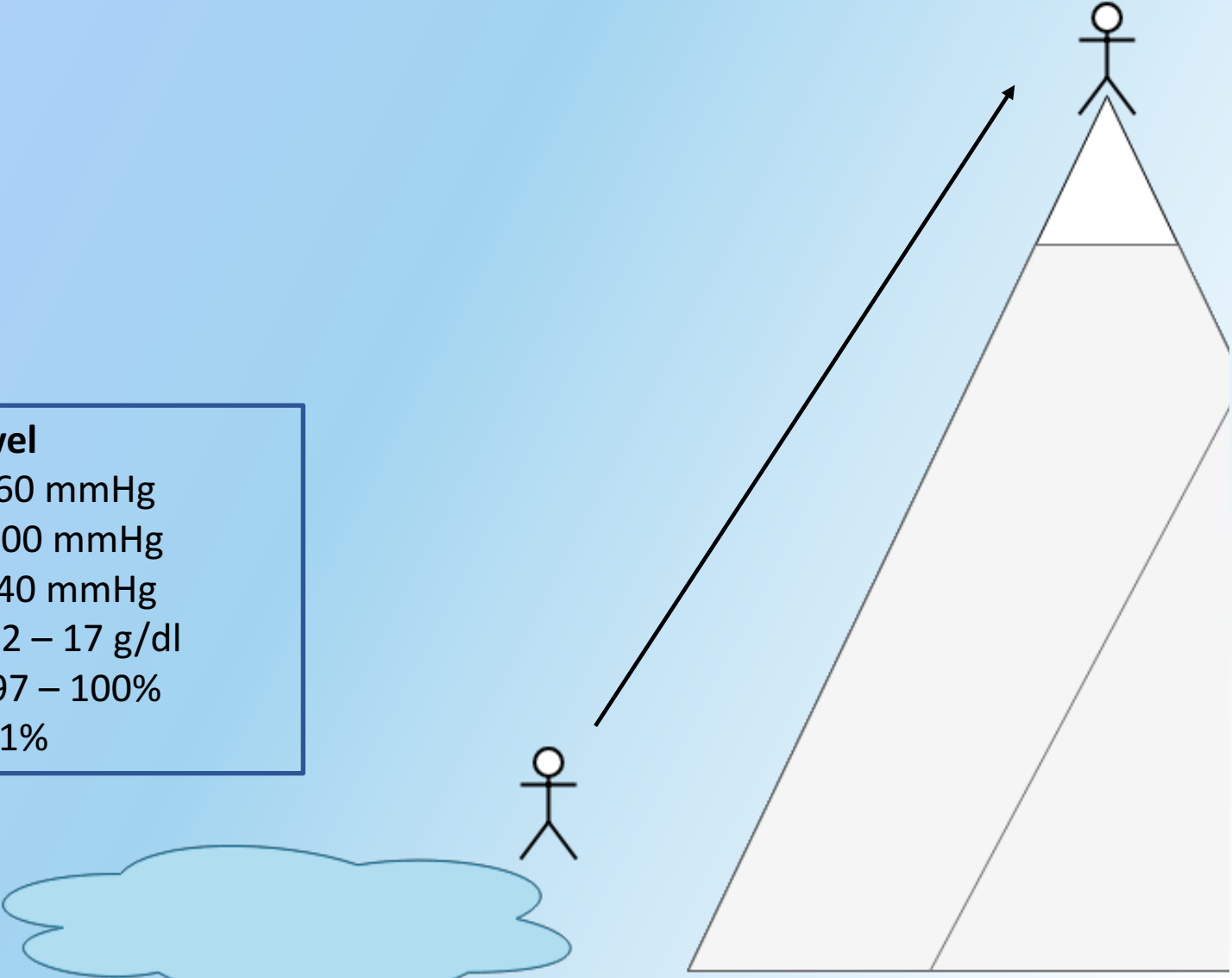
Total oxygen content = $P_{aO_2} + [Hb] + S_{aO_2}$



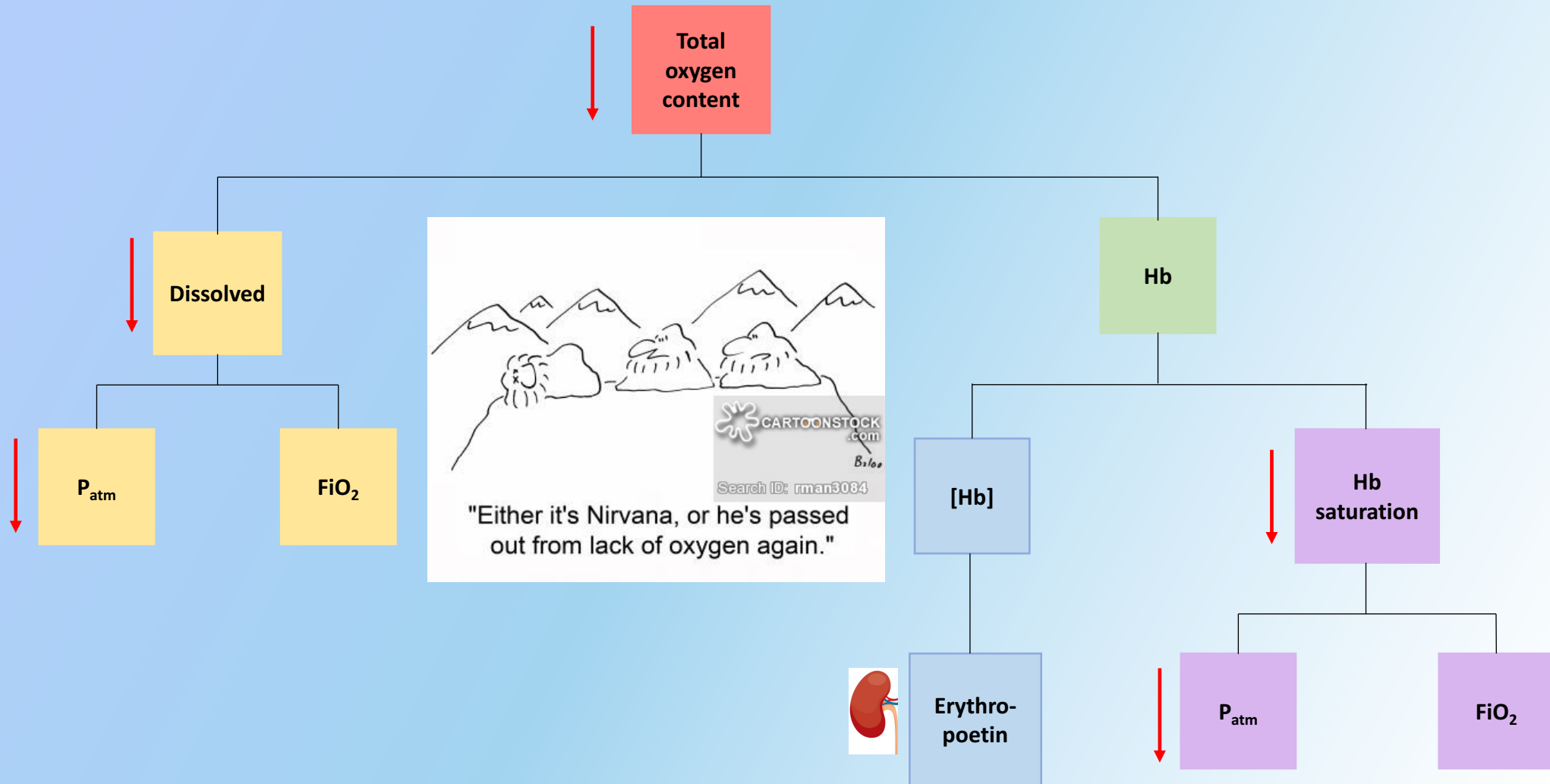


P_{atm} : 228 mmHg

Sea level
 P_{atm} : 760 mmHg
 P_{aO_2} : 100 mmHg
 P_{aCO_2} : 40 mmHg
[Hb]: 12 – 17 g/dl
 SaO_2 : 97 – 100%
 FiO_2 : 21%



Acute changes





Acute changes

P_{aO_2} : ↓
 P_{aCO_2} : ↓
Arterial pH: ↑
[Hb]: normal
 SaO_2 : ↓

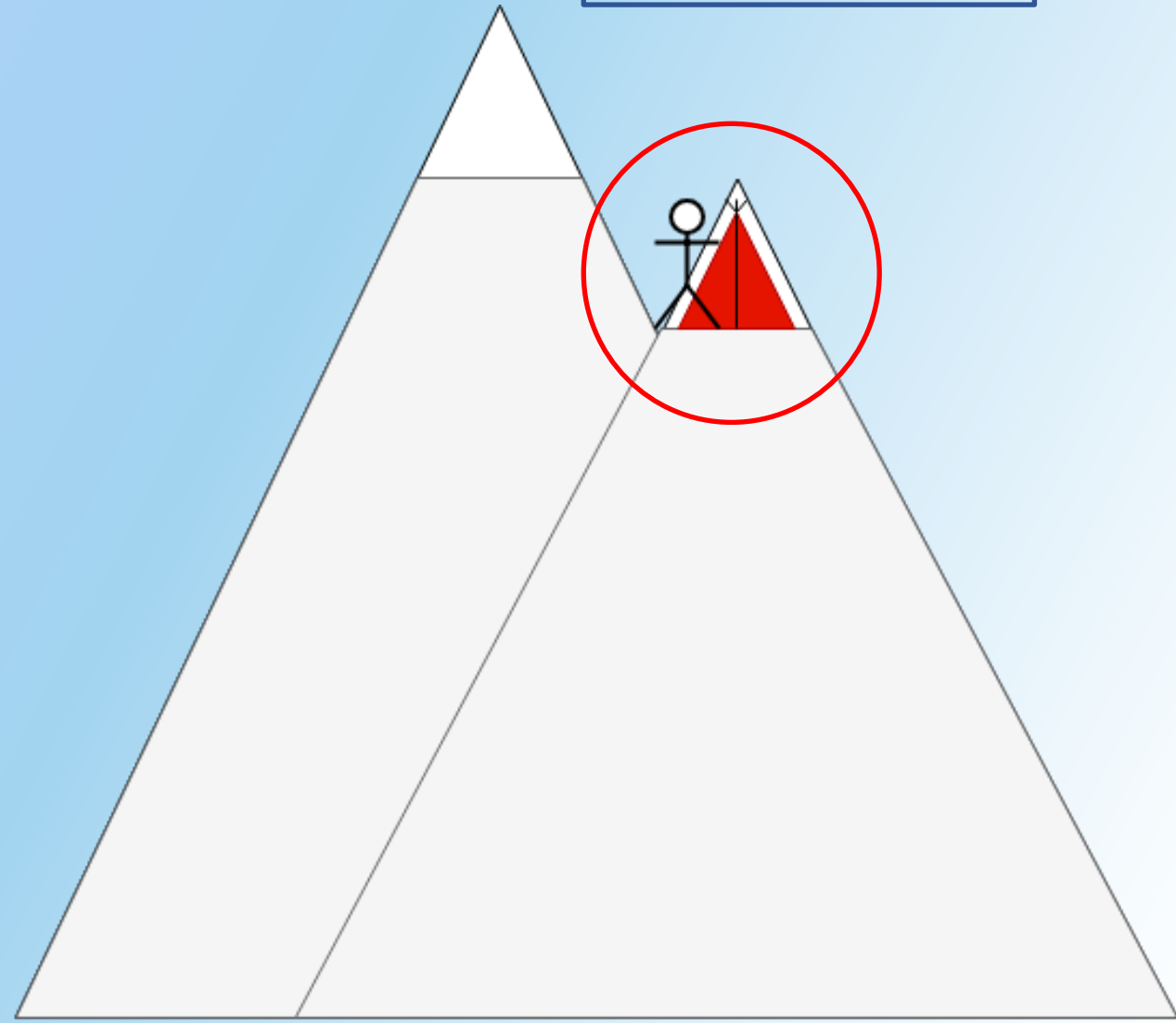
P_{atm} : 228 mmHg

Sea level

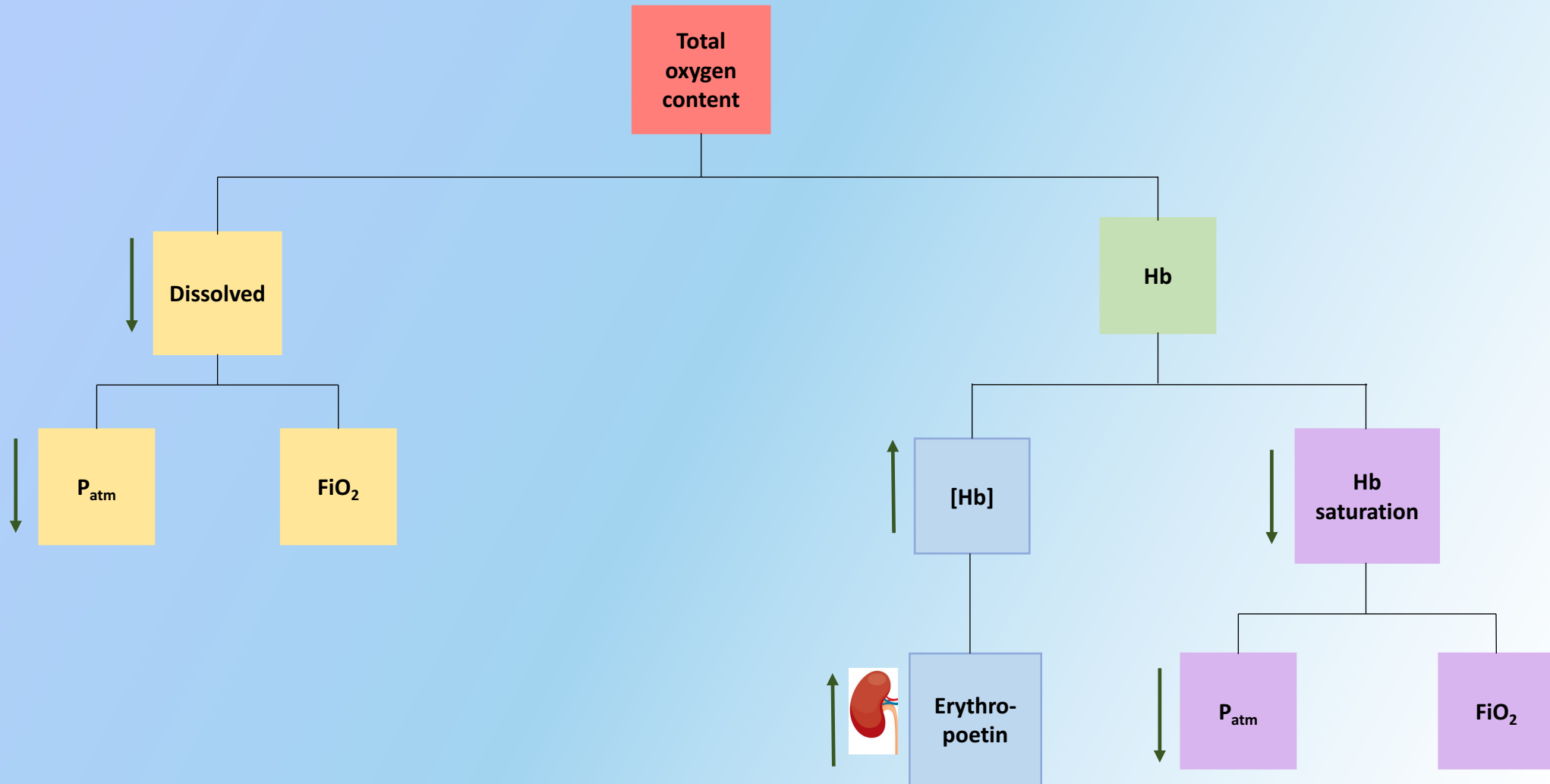
P_{atm} : 760 mmHg
 P_{aO_2} : 100 mmHg
 P_{aCO_2} : 40 mmHg
[Hb]: 12 – 17 g/dl
 SaO_2 : 97 – 100%
 FiO_2 : 21%

Sea level
 P_{atm} : 760 mmHg
 P_{aO_2} : 100 mmHg
 P_{aCO_2} : 40 mmHg
[Hb]: 12 – 17 g/dl
 SaO_2 : 97 – 100%
 FiO_2 : 21%

P_{atm} : 228 mmHg



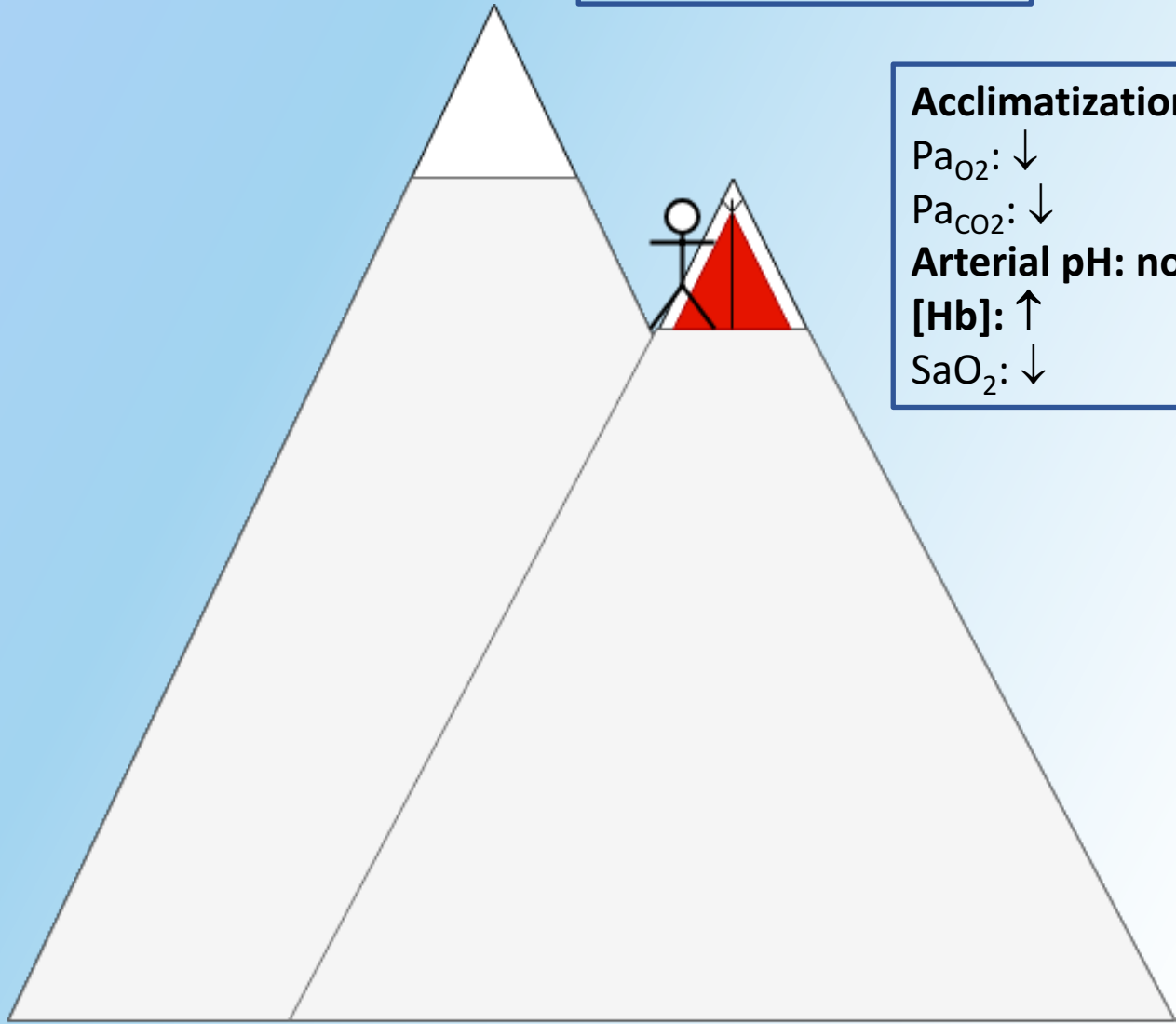
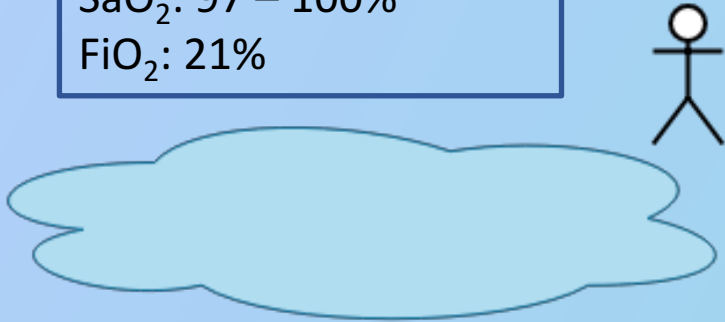
Acclimatization



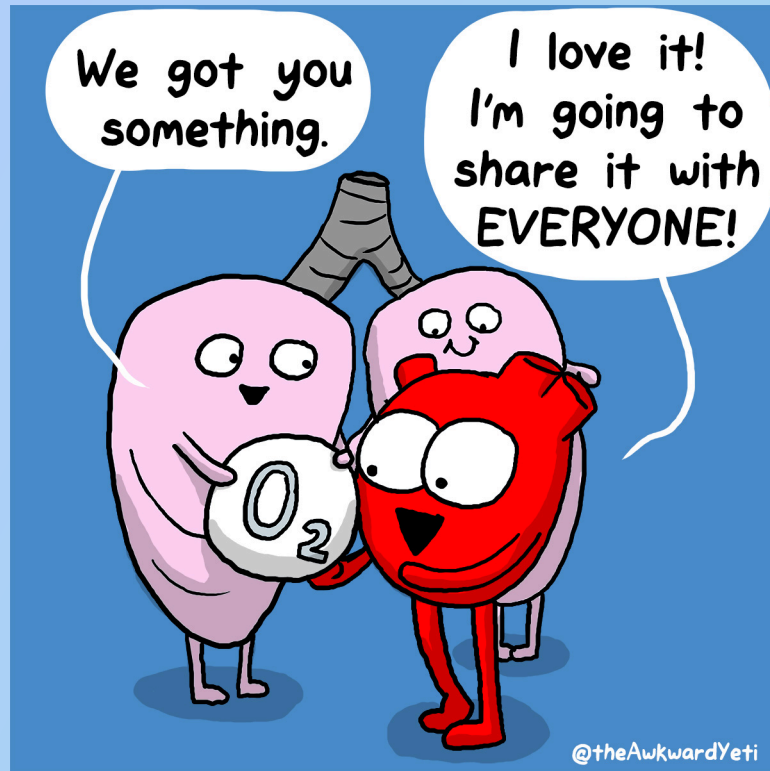
P_{atm} : 228 mmHg

Acclimatization
 P_{aO_2} : ↓
 P_{aCO_2} : ↓
Arterial pH: normal
[Hb]: ↑
 SaO_2 : ↓

Sea level
 P_{atm} : 760 mmHg
 P_{aO_2} : 100 mmHg
 P_{aCO_2} : 40 mmHg
[Hb]: 12 – 17 g/dl
 SaO_2 : 97 – 100%
 FiO_2 : 21%



GOOD LUCK! 🌟



"I know all about acclimatizing yourself for a high altitude climb, but I want to get the dinner out of the freezer!"