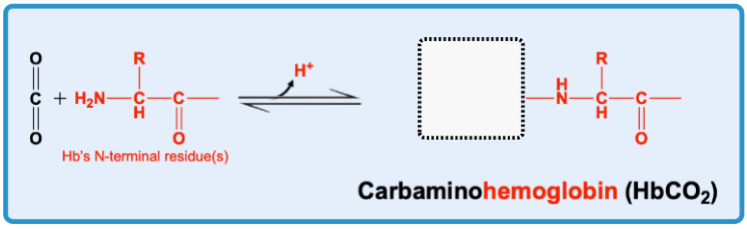
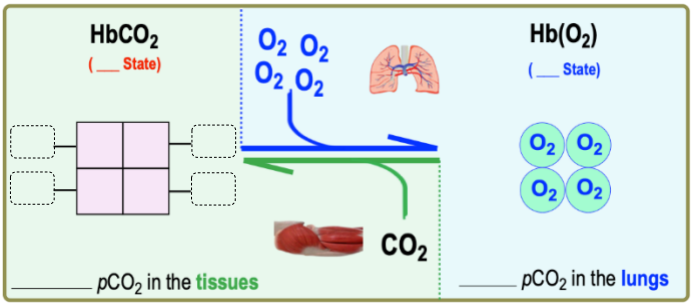
CONCEPT: HEMOGLOBIN CARBONATION & PROTONATION

Hemoglobin Carbonation ($HbCO_2$) in the Tissues

- Hb can *directly* transport *some* small amount (~10%) of _____ from the tissues to the lungs.
- Each Hb *subunit* can bind CO_2 as *carbamate* groups on *each free α-amino group* to form *carbaminohemoglobin* ($HbCO_2$).
  - □ Recall: Hb carbonation stabilizes Hb's ____ state (causing the *release* of O_2).
  - □ In the _____ pCO_2 of the *tissues*, Hb is *carbonated* & releases O_2.
  - □ In the _____ pCO_2 of the *lungs* (due to CO_2 exhalation), Hb is *decarbonated* & binds O_2.



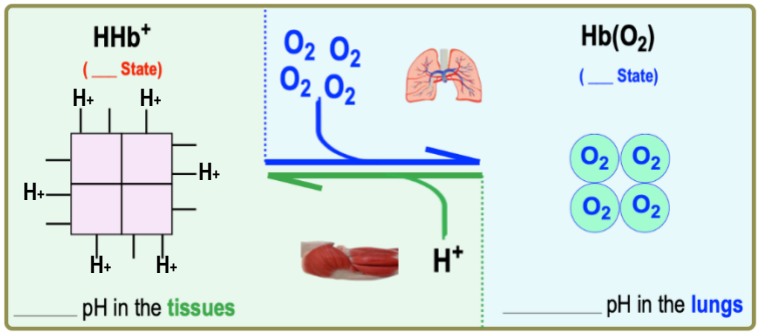


PRACTICE: Which option best corresponds with the effect of CO_2 on hemoglobin's O_2-binding?

a) Hb's O_2-affinity decreases with lower CO_2 concentration.
b) Hb's O_2-affinity increases with higher CO_2 concentration.
c) Low pCO_2 stabilizes the T state conformation of Hemoglobin.
d) High pCO_2 stabilizes the R state conformation of Hemoglobin.
e) High pCO_2 stabilizes the T state conformation of Hemoglobin.

Hemoglobin Protonation (HHb^+) in the Tissues

- Hb can become _____ on several amino acid R-groups (HHb^+) to carry H^+.
  - □ In the relatively _____ $[H^+]$ (low pH) of the *tissues*, Hb is *protonated* to form HHb^+ & release O_2.
  - □ In the relatively _____ $[H^+]$ (high pH) of the *lungs*, Hb is *deprotonated* to release H^+ & bind O_2.



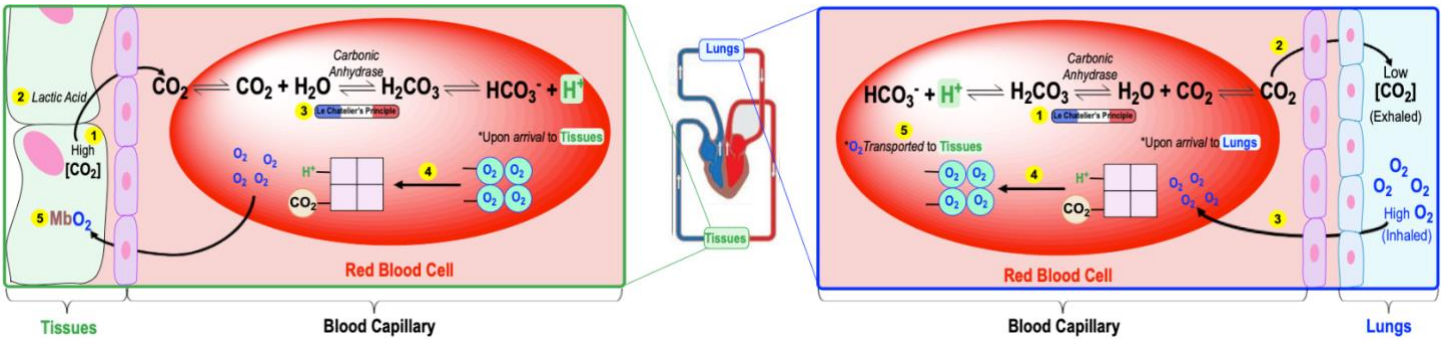
CONCEPT: HEMOGLOBIN CARBONATION & PROTONATION

PRACTICE: Which statement is true about protons binding to hemoglobin?

a) Protons stabilize the T-state increasing the affinity of hemoglobin for oxygen.
b) Protons stabilize the T-state decreasing the affinity of hemoglobin for oxygen.
c) Protons stabilize the R-state increasing the affinity of hemoglobin for oxygen.
d) Protons stabilize the R-state decreasing the affinity of hemoglobin for oxygen.

Hemoglobin Carbonation & Protonation Recap

●Let's briefly review Hb carbonation & protonation as it relates to the tissues & lungs:



PRACTICE: Alkalemia is a disease associated with an abnormal increase in the pH of a patient's blood due to rapid breathing (hyperventilation). How would alkalemia affect the oxygen binding affinity of the patient's hemoglobin?

a) P_{50} and oxygen affinity decrease.
b) P_{50} and oxygen affinity increase.
c) P_{50} decreases and oxygen affinity increases.
d) P_{50} increases and oxygen affinity decreases.
e) P_{50} and oxygen affinity remain the same.

PRACTICE: Choose all of the following molecules that, when bound, trigger hemoglobin's transition from T to R state.

a) CO_2
b) CO
c) O_2
d) 2,3-Bisphosphoglycerate
e) H_+