CONCEPT: HEMOGLOBIN COOPERATIVITY

Hemoglobin Displays Positive Cooperativity

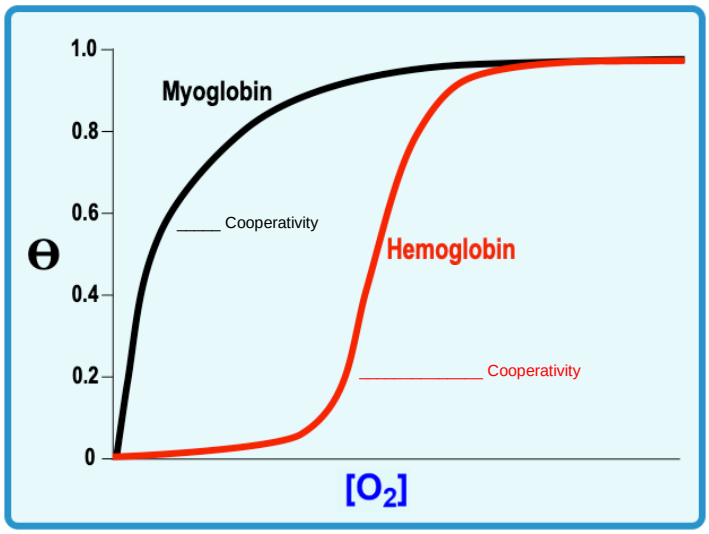
●Hemoglobin O_2-binding displays _____ behavior (S-shaped curve) due to *positive* cooperativity.

●Recall: *Positive Cooperativity*: binding of one **L** molecule makes it _____ for other **L** molecules to bind the proteins.

□ *Positive Cooperativity*: binding of **L** to a subunit promotes neighboring subunits to take on the ____ state.

●Cooperativity *requires* multiple subunits, so _____ O_2-binding is *NOT* sigmoidal (has rectangular hyperbola).

EXAMPLE: Mb vs. Hb O_2-binding.

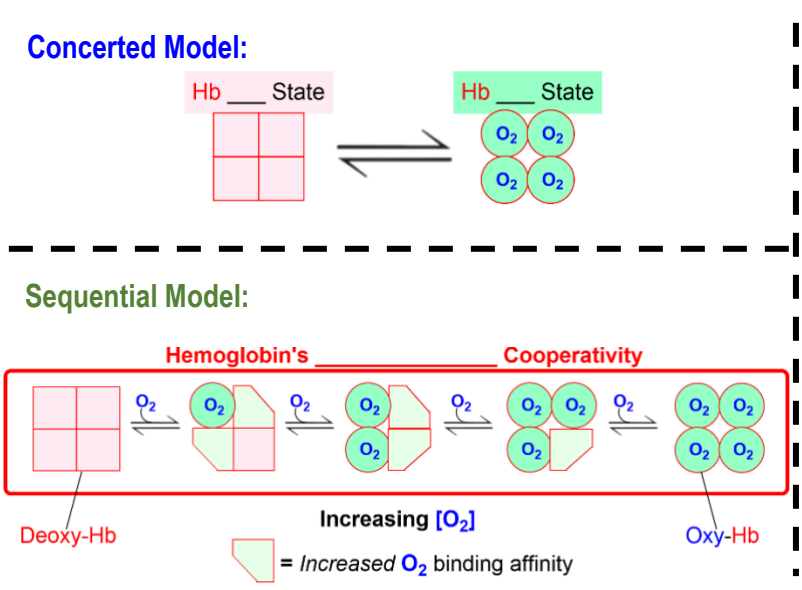


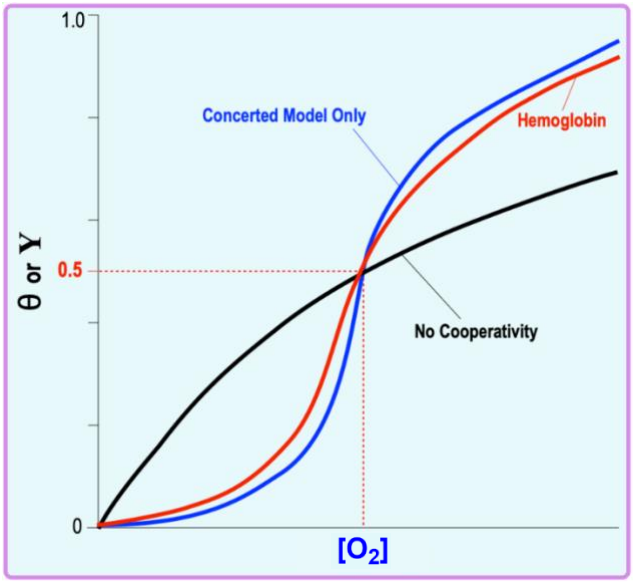
Concerted & Sequential Models Explain Hb's Positive Cooperativity

●Recall: _____ models can explain an allosteric protein's *positive cooperativity* & *sigmoidal curvature*:

●Hemoglobin's O_2-binding behavior is best explained via a _____ of *concerted* & *sequential* models.

□Deoxygenated hemoglobin (Hb): *inactive* tense __ State. □Oxygenated hemoglobin (HbO_2): *actively* relaxed __ State.





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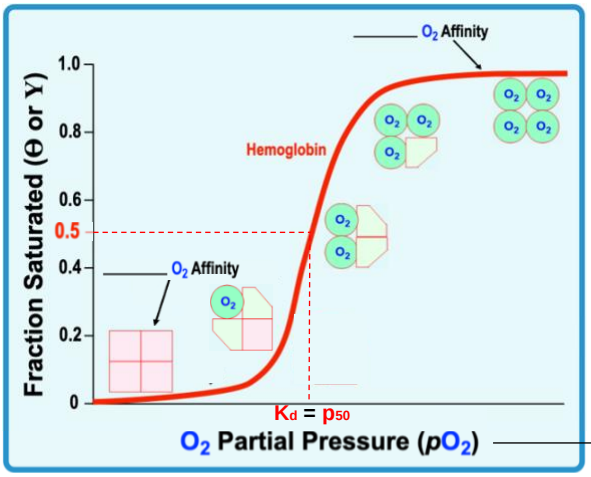
Oxygen-Binding Curves

●*Oxygen-Binding Curves*: plot *fractional saturation* (___ or ___) against the *partial pressure* of O_2 (____).

□ Since O_2 is a gas, *partial pressure* of O_2 (pO_2) is a standard way to express _____.

□ pO_2 is *directly* _____ to [O_2]. □ K_d = _____ on an oxygen-binding curve.

●O_2 itself acts as a *homotropic allosteric* _____ (+) to induce *positive cooperativity* in Hb's subunits.



→ Unit of Pressure (ex. _____)

O_2 is a _____ allosteric *activator* that _____ additional binding of O_2 to **Hb**.

Positive Cooperativity Makes Hb a Better O_2 Transporter than Mb

●Recall: _____ *Cooperativity*: binding of O_2 to Hb stimulates even _____ O_2 binding.

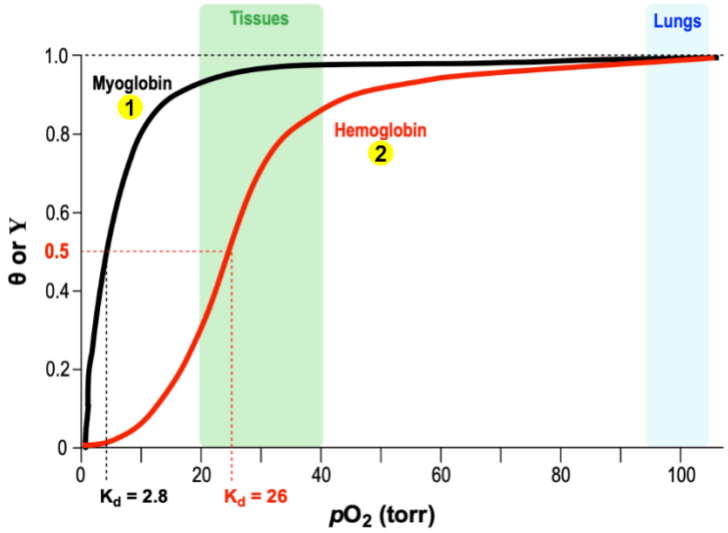
□ Cooperativity allows _____ to be a *better* deliverer/transporter of O_2 to the tissues than _____ for two reasons:

1. Mb *cannot* transport O_2 because it has a _____ K_d (_____ O_2 affinity) & would *NOT* release O_2 in the tissues.
2. Threshold effect in Hb allows Hb to release _____ O_2 in tissues that work "harder" and have *lower* O_2.

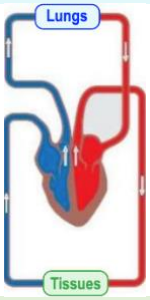
EXAMPLE: Which enzyme has a *stronger* affinity for O_2?

a) Myoglobin.

b) Hemoglobin.



pO2 in Lungs ≈ 100 torr
Hemoglobin Saturation in Lungs ≈ 98%
Myoglobin Saturation in Lungs ≈ 99%



pO2 in Tissues ≈ 20 torr
Hemoglobin Saturation in Tissues ≈ 32%
Myoglobin Saturation in Tissues ≈ 95%

●Heterotropic allosteric effectors (ex. _____) further enhance hemoglobin's release of O_2 in the tissues.

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PRACTICE: In the binding of oxygen to myoglobin, the relationship between the concentration of oxygen and the fraction of binding sites occupied can best be described as:

a) Hyperbolic.
b) Linear with a negative slope.
c) Linear with a positive slope.
d) Random.
e) Sigmoidal.

PRACTICE: Oxygen is a _____ allosteric _____ that promotes additional O_2 binding to hemoglobin.

a) Heterotropic, Repressor.
b) Homotropic, Activator.
c) Heterotropic, Activator.
d) Homotropic, Repressor.

PRACTICE: The binding of Oxygen to stabilize the R-state of Hemoglobin is best explained by which model(s)?

a) Concerted Model.
b) Sequential Model.
c) Neither.
d) Combination of Both.