



The free energy to *form* the complex is the opposite of the free energy to *break* the complex.

$$\Delta G_{\text{associate}}^{O_2} = -\Delta G_{\text{dissociate}} = -\left(\Delta G^{\circ'} + RT \ln \left(\frac{[Hb][O_2]}{[Hb \cdot O_2]} \right)\right)$$

The free energy to bind O_2 at the first site is:

$$\Delta G_{\text{bind},1} = \Delta G_{T \rightarrow R} - \left(\Delta G^{\circ'} + RT \ln \left(\frac{[Hb][O_2]}{[Hb \cdot O_2]} \right)\right) = \Delta G_{T \rightarrow R} + \Delta G_{O_2}$$

where $\Delta G_{T \rightarrow R} > 0$.

1. What happens to $\Delta G_{\text{bind},1}$ as $[O_2]$ goes up? Why?

$[O_2] \uparrow$, $\Delta G_{\text{bind},1} \downarrow$ (MORE NEGATIVE). THIS IS BECAUSE BOUND STATE BECOMES MORE FAVORABLE BECAUSE MORE REACTANT AROUND.

2. Write an expression for $\Delta G_{\text{bind},2}$ (binding of the *second* O_2 molecule). Is it *easier* or *harder* to bind O_2 at the second site? Why?

$\Delta G_{\text{bind},2} = \Delta G_{O_2}$ EASIER. DON'T HAVE TO "PAY" FOR T→R TRANSITION.

3. What about binding at the third and fourth sites?

SAME AS #2 SITE

4. Can you justify the sigmoidal shape of the binding curve from these observations?

