Plan

Gjenta og utvid Hemoglobin-modell
- 9,6 s376 →

C 8 oder:

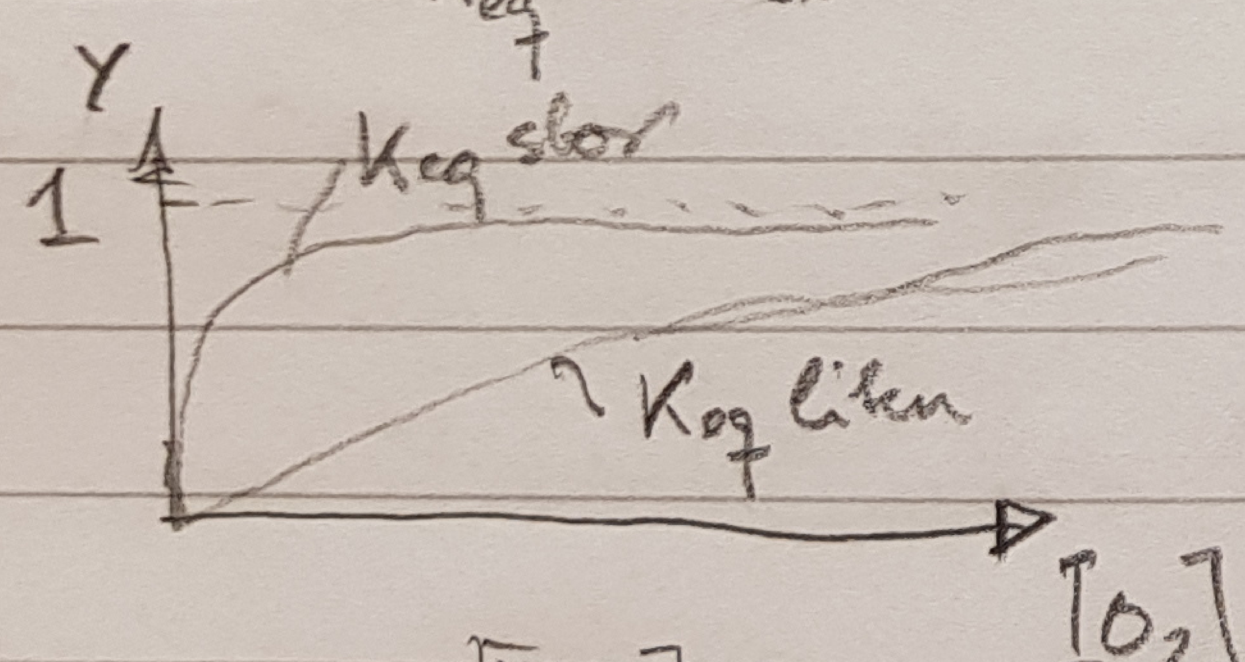
$$Hb + O_2 \rightleftharpoons HbO_2$$

$$K_{eq} = \frac{[HbO_2]}{[Hb][O_2]}$$

$$Y = \frac{[HbO_2]}{[Hb]+[HbO_2]} =$$

$$\frac{1}{Y} = \frac{[Hb]}{[HbO_2]} + 1 = \frac{1}{K_{eq}[O_2]} + 1 = \frac{K_{eq}[O_2]+1}{K_{eq}[O_2]}$$

$$\Rightarrow Y = \frac{[O_2]}{K_{eq}^{-1} + [O_2]}$$




$$Y = 1 - P(0) = \frac{[HbO_2]}{[Hb]+[HbO_2]}$$

Hills fractional binding: binding to n sites at once.

$$Hb + nO_2 \rightleftharpoons Hb(O_2)_n$$

$$K_{eq} = \frac{[Hb(O_2)_n]}{[Hb][O_2]^n}$$

$$\frac{1}{Y} = \frac{K_{eq}[O_2]^n + 1}{K_{eq}[O_2]^n}$$

$$Y = \frac{[O_2]^n}{K_{eq} + [O_2]^n} = \frac{o^n}{K + o^n}$$

Derive og plot!

Has inflection point? $\frac{\partial^2 Y}{\partial [O_2]^2} = 0$

$$\frac{\partial Y}{\partial o} = \frac{n o^{n-1}(K + o^n) - n o^{n-1} \cdot o^n}{(K+o^n)^2} = \frac{K n o^{n-1}}{(K+o^n)^2}$$

$$\frac{\partial^2 Y}{\partial o^2} = \frac{K n (n-1) o^{n-2}(K+o^n)^2 - 2(K+o^n) n o^{n-1}}{(K+o^n)^4}$$

$$K(n-1)(K+o^n) - 2o = 0$$

$$K^2(n-1) + K(n-1)o^n - 2o = 0$$

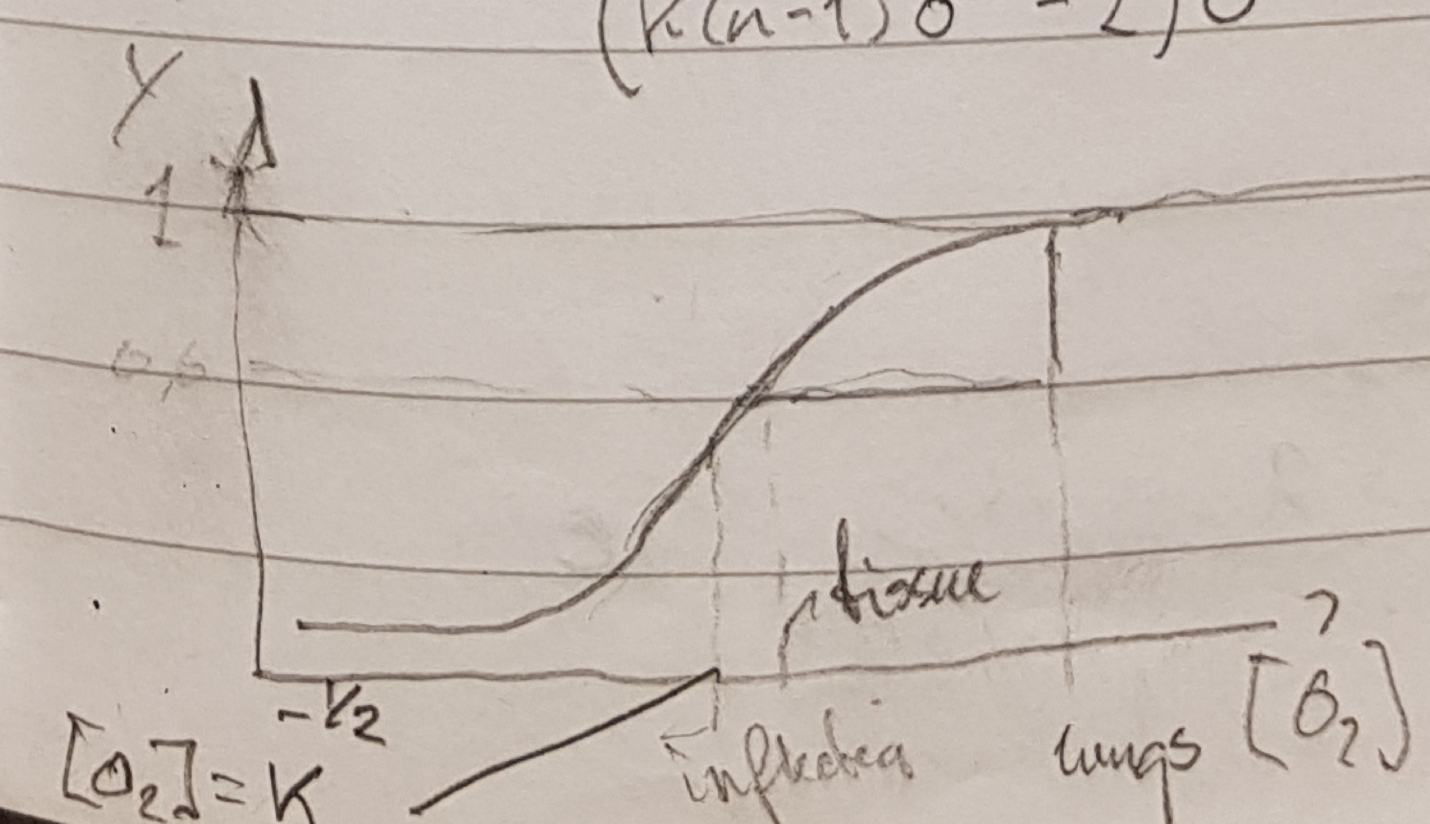
$$(K(n-1)o^{n-1} - 2)o = -K^2(n-1)$$

$o = -K^2(n-1)$ nei

$o = \sqrt[n-1]{\frac{2}{K(n-1)}}$

$n=3$ $o = \sqrt{\frac{1}{K}} = K^{-1/2}$

1




tissue close to inflection point (steepest grade) ⇒ change in "demand" ($[O_2]$ low) will quickly deliver

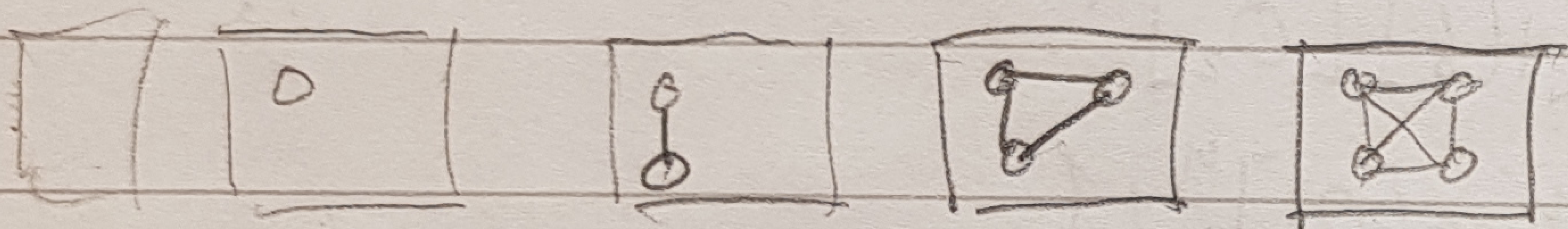
Physical biology of the cell 298 - 305

Allostery - Binding at one site affects binding at another site.

structural forms

Cooperativity

Pauling model pairwise interactions



J=1 J=3 J=6

J

state variables $[s_1\ s_2\ s_3\ s_4]$ $s_i = \{0, 1\}$

$$Z = 1 + 4e^{-\beta(\varepsilon-\mu)} + 6e^{-2\beta(\varepsilon-\mu)-\beta J} + 4e^{-3\beta(\varepsilon-\mu)-3\beta J} + e^{-4\beta(\varepsilon-\mu)-6\beta J}$$

$a = e^{-\beta\varepsilon}$ $\lambda = e^{\beta\mu}$ $\gamma = e^{-\beta J}$

$$Z = 1 + 4a\lambda + 6a^2\lambda^2\gamma + 4a^3\lambda^3\gamma^3 + a^4\lambda^4\gamma^6$$

plott sannsynligheten

$$\mu = \mu(c_0) + kT\ln\frac{c}{c_0}$$

$$e^{+\beta\mu} = e^{+\beta\mu_0}\cdot\frac{c}{c_0} = \lambda \qquad \frac{c_0\lambda}{e^{\beta\mu_0}} = c$$

| | Non-interact | Pauling |
|---|---|---|
| Energy of system ($\varepsilon < 0$ for binding) $s_i = \begin{cases}0 & \text{empty}\\ 1 & \text{occupied}\end{cases}$ $\varepsilon = 0$ | $E = \varepsilon\sum_{i=1}^{4} s_i$ | $E = \varepsilon\sum_{i=1}^{4} s_i + J\sum_{i=1}^{4}\sum_{j=i}^{4} s_i s_j$ |
| | $N = 0\ 1\ 2\ 3\ 4$ <br> $0\ \varepsilon\ 2\varepsilon\ 3\varepsilon\ 4\varepsilon$ | $0\ 1\ 2\ 3\ 4$ <br> $0\ \varepsilon\ 2\varepsilon\text{-}J\ 3\varepsilon\text{-}3J\ 4\varepsilon\text{-}6J$ |
| $N=0$ $P(0)Z_G$ = | $1$ | $1$ |
| $N=1$ $P(1)Z_G$ = | $e^{-\beta N(\varepsilon-\mu)} = a\lambda$ | $= e^{-\beta N(\varepsilon-\mu)} = a\lambda$ |
| $N=2$ $P(2)Z_G$ = | $e^{-2\beta(\varepsilon-\mu)} = (a\lambda)^2$ | $= e^{-2\beta(\varepsilon-\mu)-\beta J}$ $(a\lambda)^2\gamma$ |
| $N=3$ $P(3)Z_G$ = | $e^{-3\beta(\varepsilon-\mu)} = (a\lambda)^3$ | $= e^{-3\beta(\varepsilon-\mu)-3J\beta}$ $(a\lambda)^3\gamma^3$ |
| $N=4$ $P(4)Z_G$ = | $e^{-4\beta(\varepsilon-\mu)} = (a\lambda)^4$ | $= e^{-4\beta(\varepsilon-\mu)-6J\beta}$ $(a\lambda)^4\gamma^6$ |

Put in proper concentration scales

Henry's law in lungs.

Coupled to $O_2$ transport → muscels

ATP ?