Enzymes

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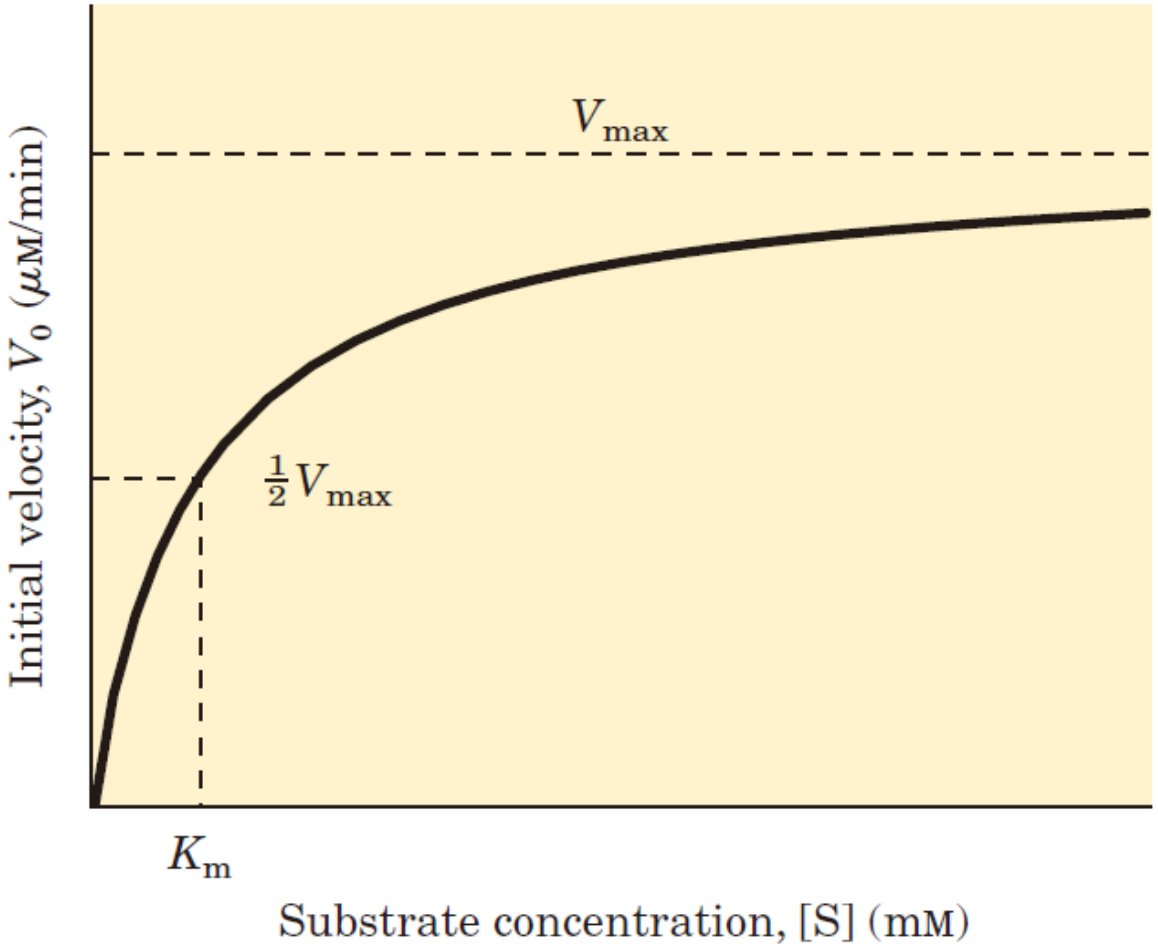
2020-10-22

Michaelis-Menten equation: $$v = \frac{V_{max} \cdot [S]}{K_m + [S]}$$



Regulations of enzyme activity

- reversible regulations 可逆调控

  reversible inhibitors

  allosteric modulators

  post-translational modifications

- irreversible regulations 不可逆调控

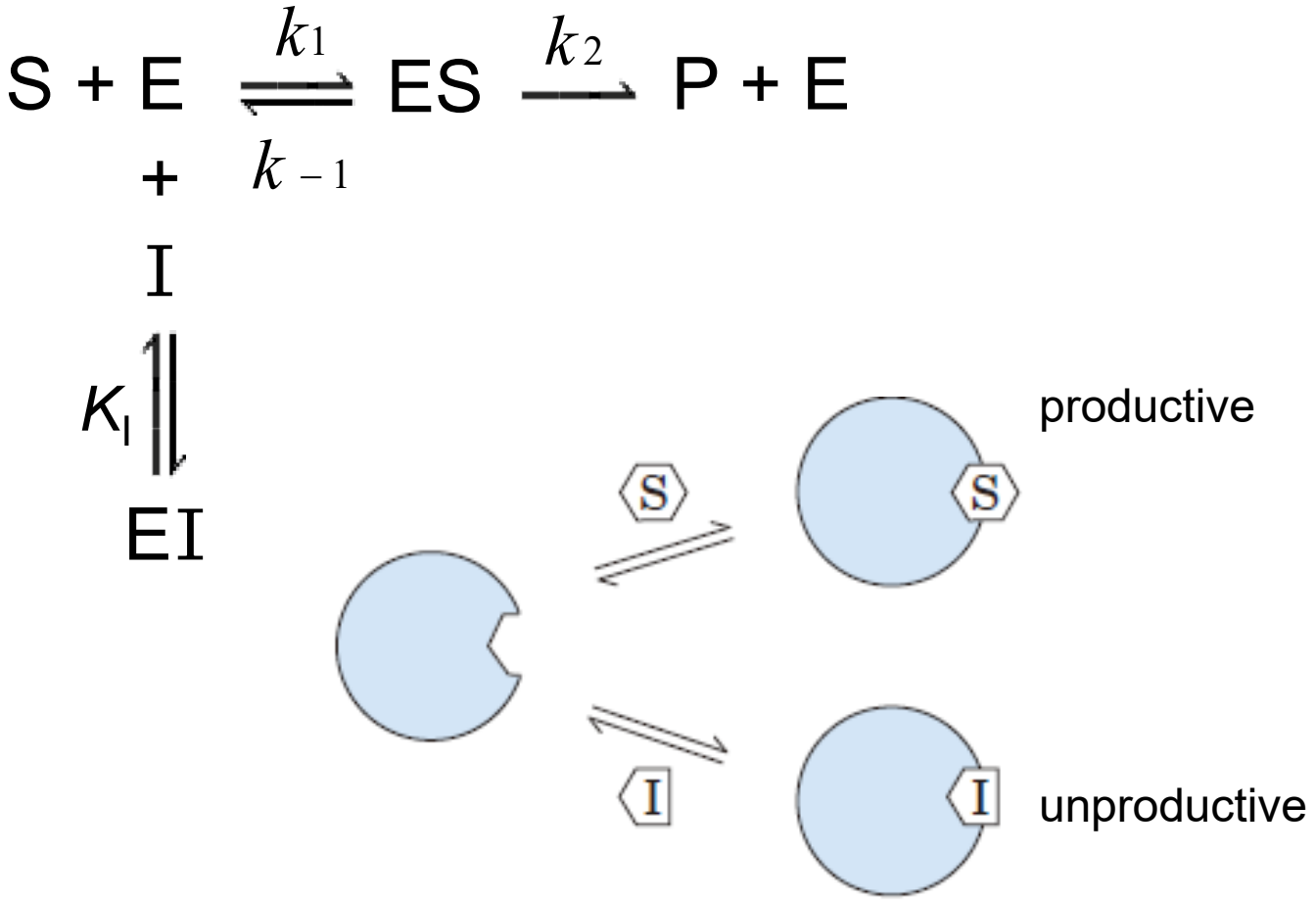
  irreversible inhibitors

  zymogen activation（酶原激活）

  ……

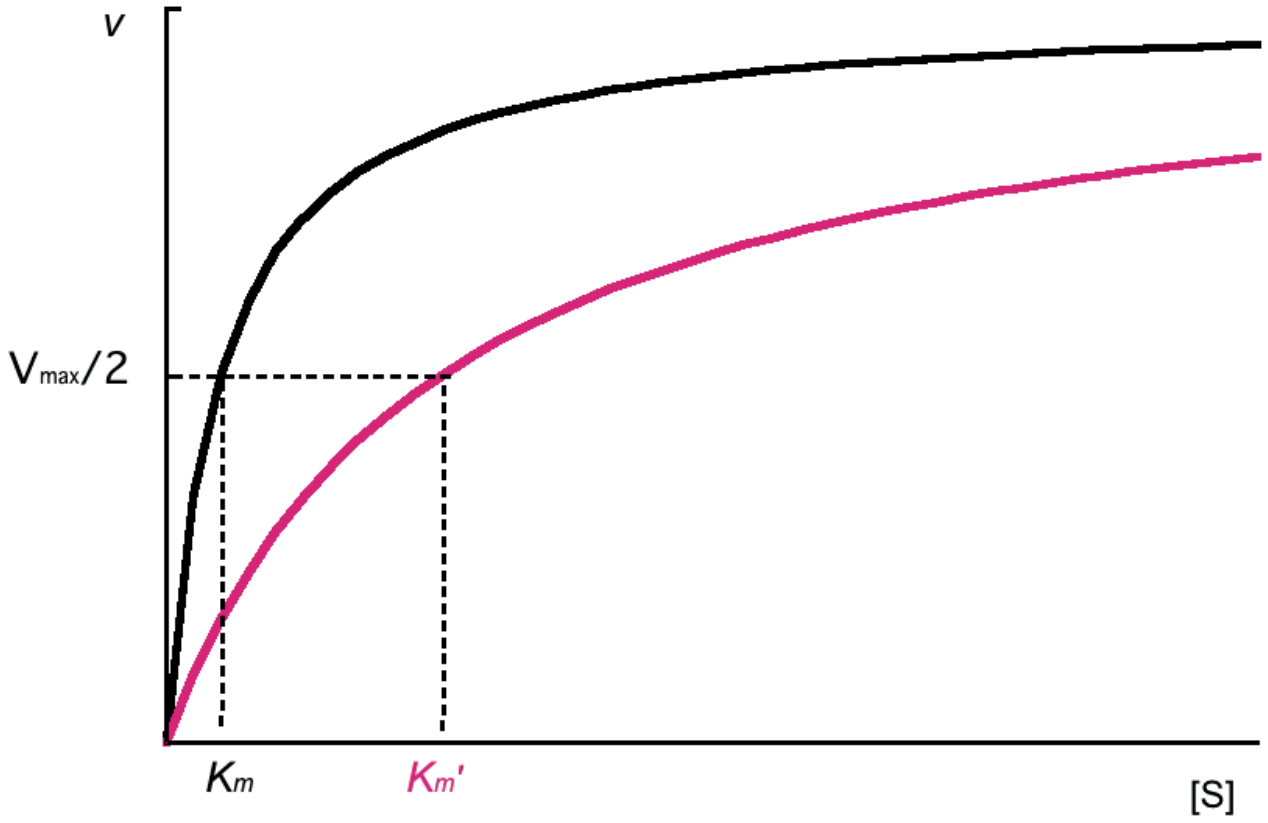
万物皆可控

Competitive inhibitor 竞争性抑制剂



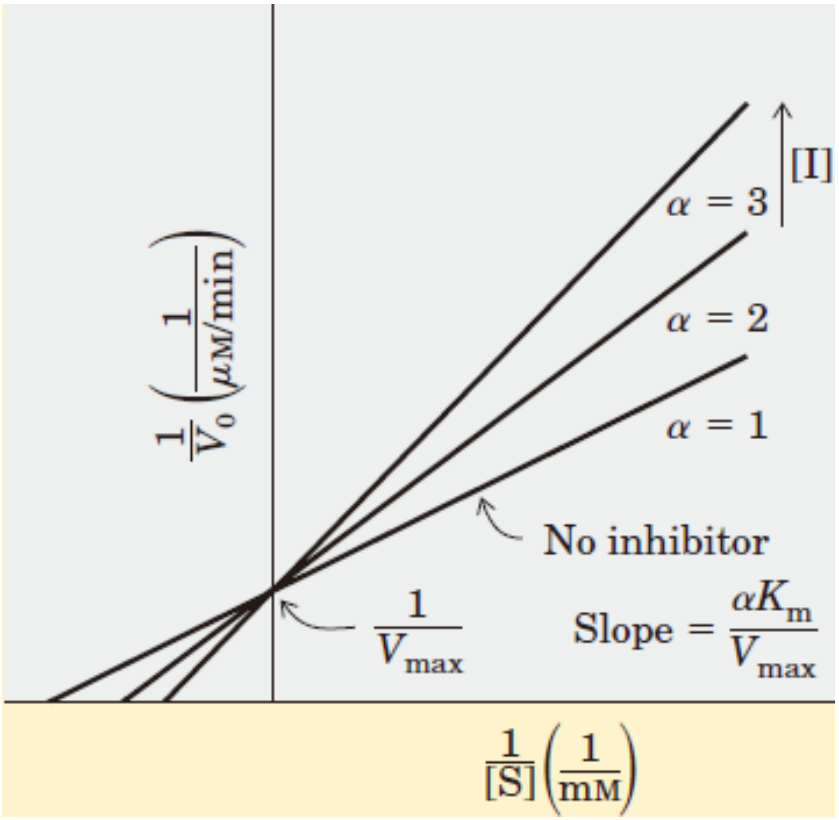
Competitive inhibitor 竞争性抑制剂

$$v = \frac{V_{max} \cdot [S]}{\alpha K_m + [S]}, \quad \alpha = 1 + \frac{[I]}{K_I}$$



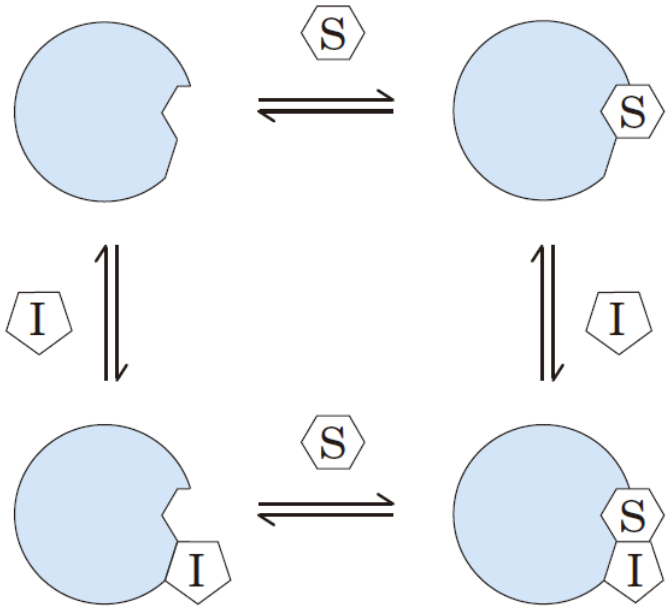
Competitive inhibitor 竞争性抑制剂

$$v = \frac{V_{\max} \cdot [\mathrm{S}]}{\alpha K_{\mathrm{m}} + [\mathrm{S}]}, \quad \alpha = 1 + \frac{[\mathrm{I}]}{K_{\mathrm{I}}}$$



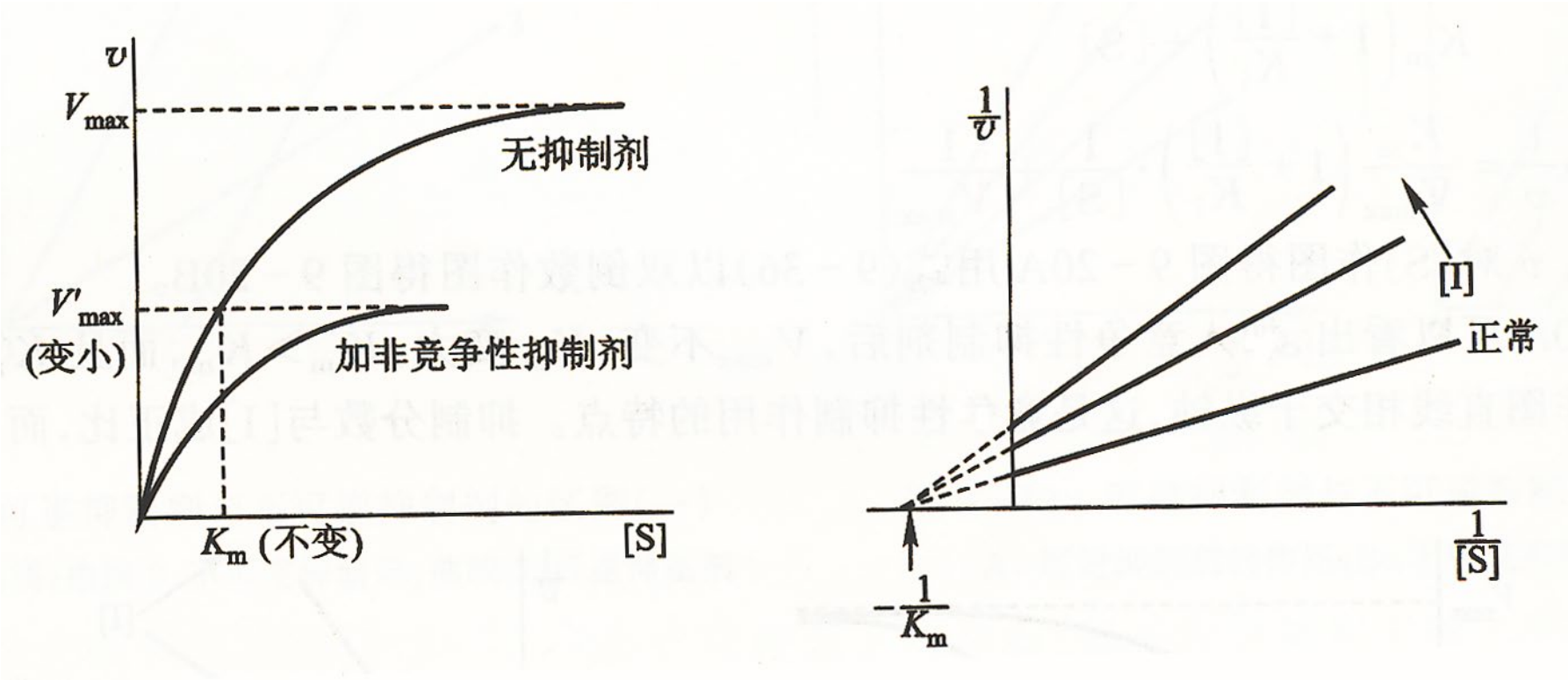
noncompetitive inhibitor 非竞争性抑制剂

$$
\begin{array}{ccccc}
E + S & \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} & ES & \xrightarrow{k_2} & P + E \\
+ & & + & & \\
I & & I & & \\
K_I \Vert & & K_I \Vert & & \\
EI + S & \rightleftharpoons & ESI & &
\end{array}
$$



noncompetitive inhibitor 非竞争性抑制剂

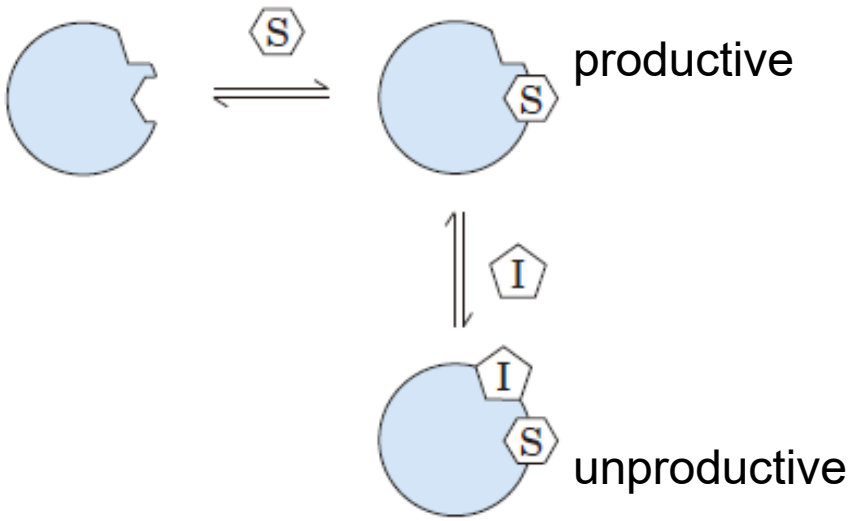
$$v = \frac{V_{\max}\cdot[\mathrm{S}]}{\alpha\left(K_{\mathrm{m}}+[\mathrm{S}]\right)},\ \alpha = 1+\frac{[\mathrm{I}]}{K_{\mathrm{I}}}$$



uncompetitive inhibitor 反竞争性抑制剂

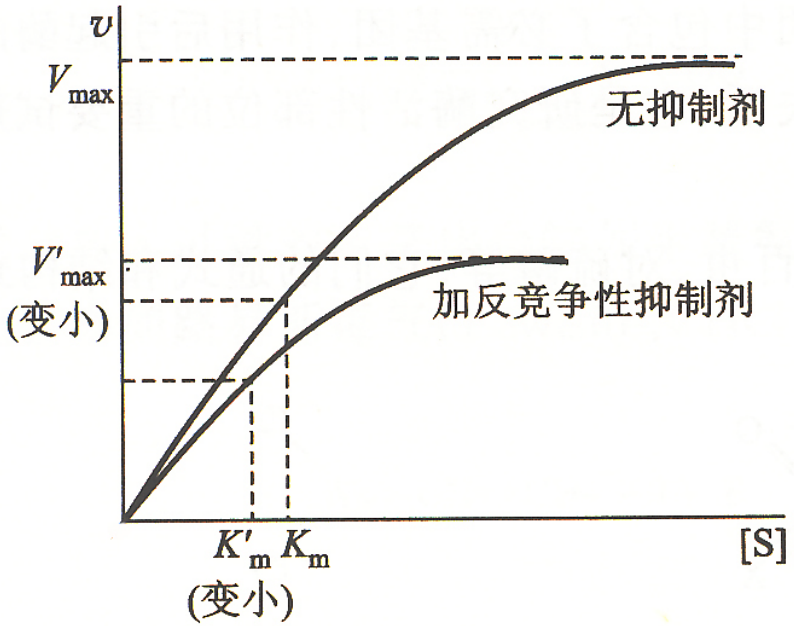
$$S + E \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} P + E$$

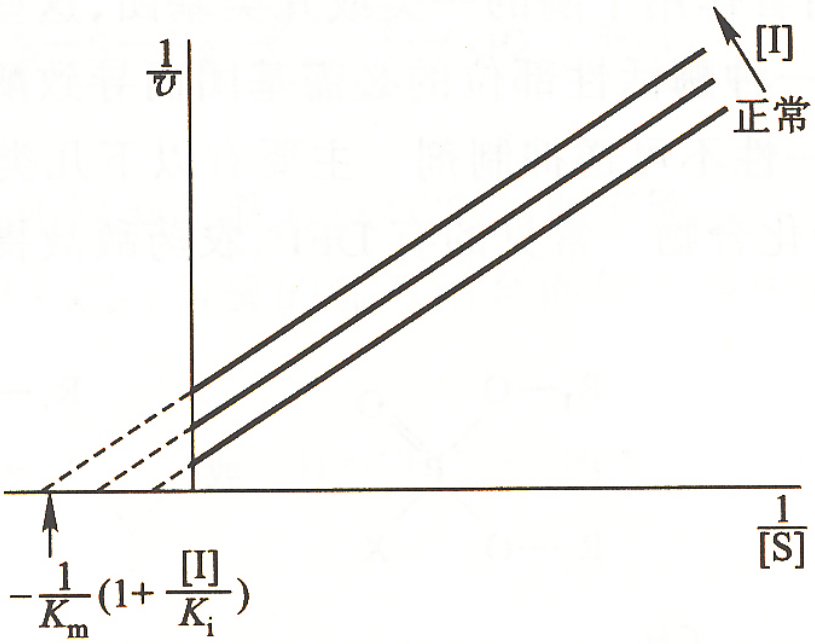
$$ES + I \overset{K_I}{\rightleftharpoons} ESI$$



uncompetitive inhibitor 反竞争性抑制剂

$$v = \frac{V_{max} \cdot [S]}{K_m + \alpha[S]}, \quad \alpha = 1 + \frac{[I]}{K_I}$$



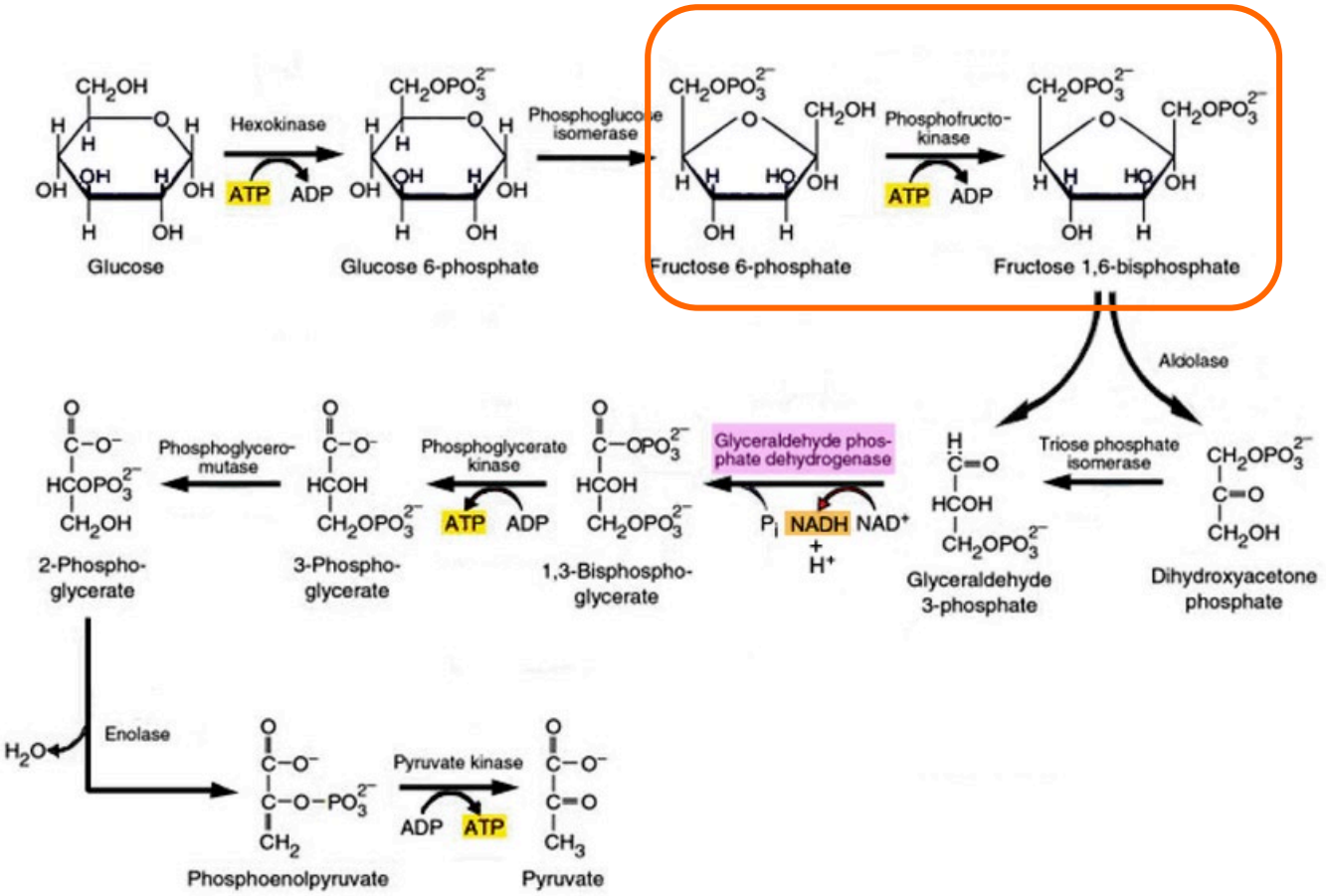


Regulation of enzyme activity

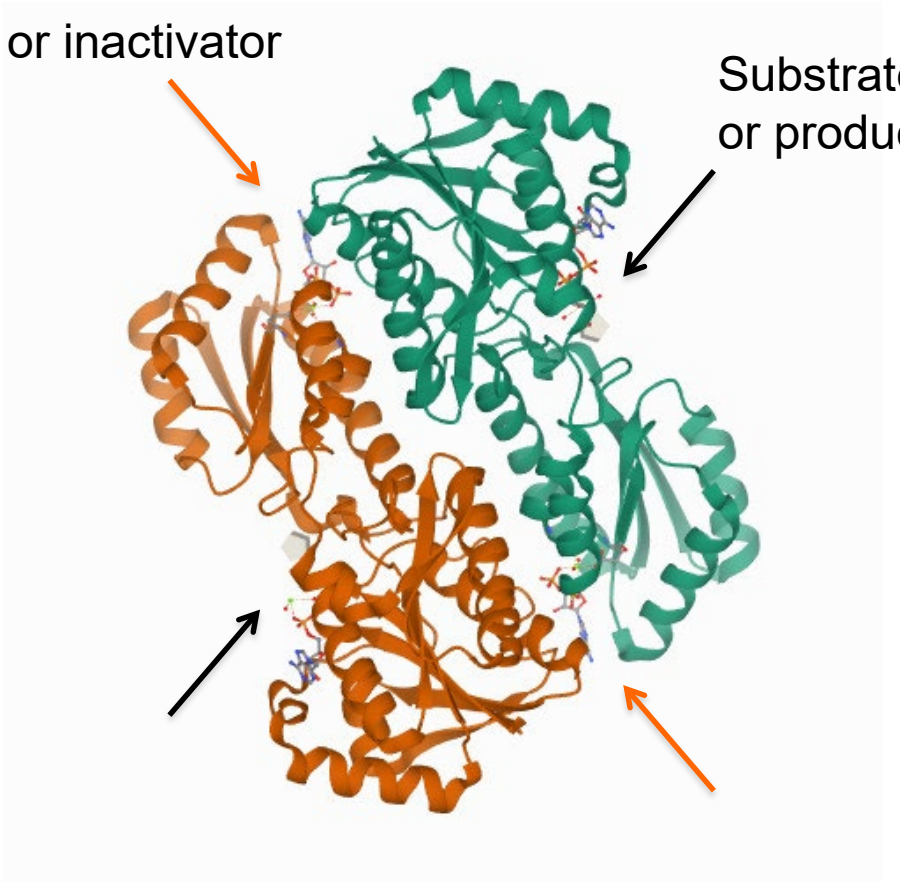
- reversible regulation
  - reversible inhibitors
  - allosteric modulators
  - post-translational modifications
- irreversible regulation
  - irreversible inhibitors
  - zymogen activation
  - ……

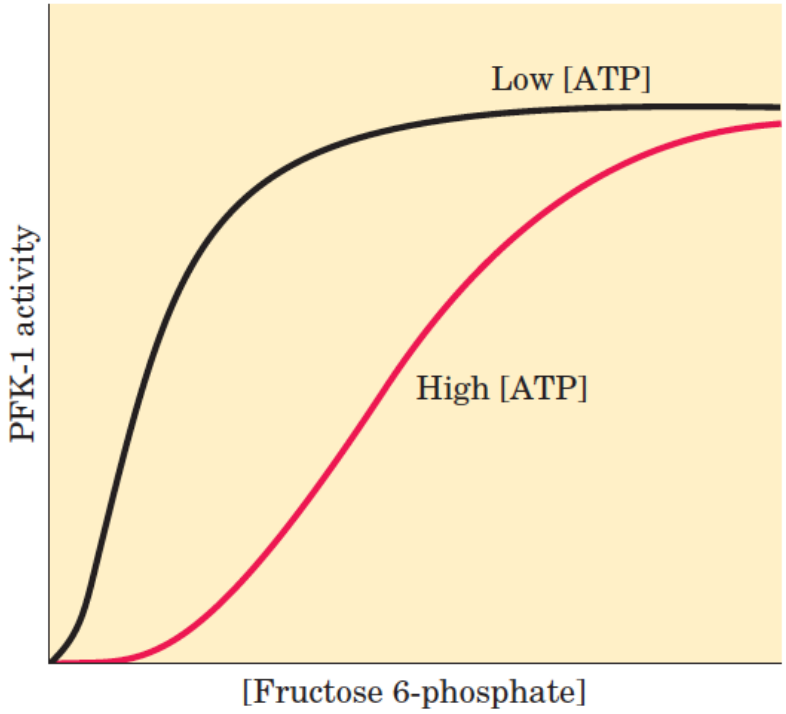
万物皆可控

Allosteric enzymes: PFK as an example (phosphofructokinase 磷酸果糖激酶)

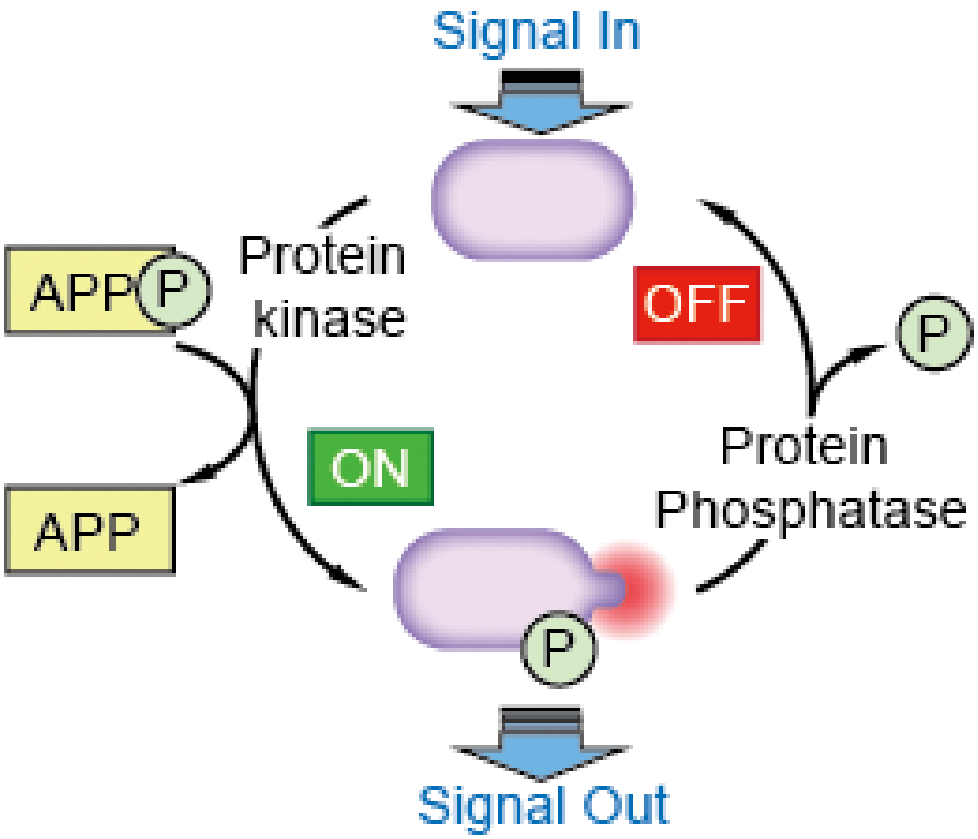


Allosteric enzymes: PFK as an example (phosphofructokinase 磷酸果糖激酶)



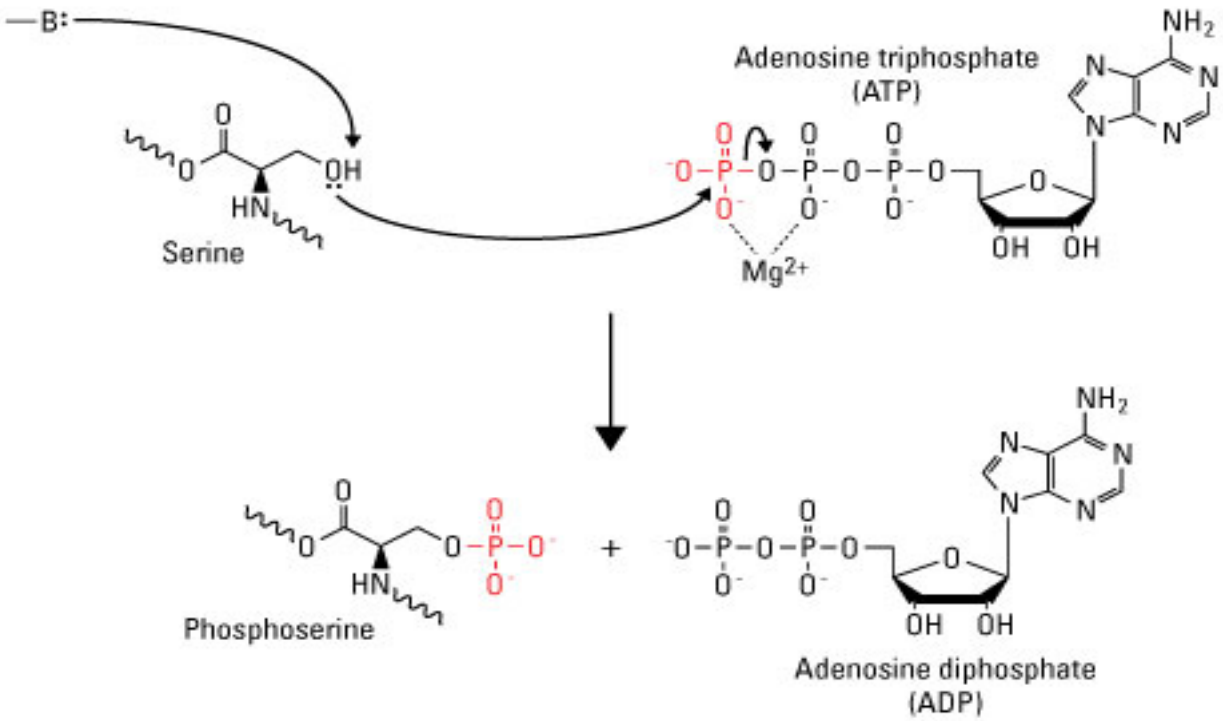


Protein phosphorylation



kinase

激酶



phosphatase

磷酸酶

phosphorylase

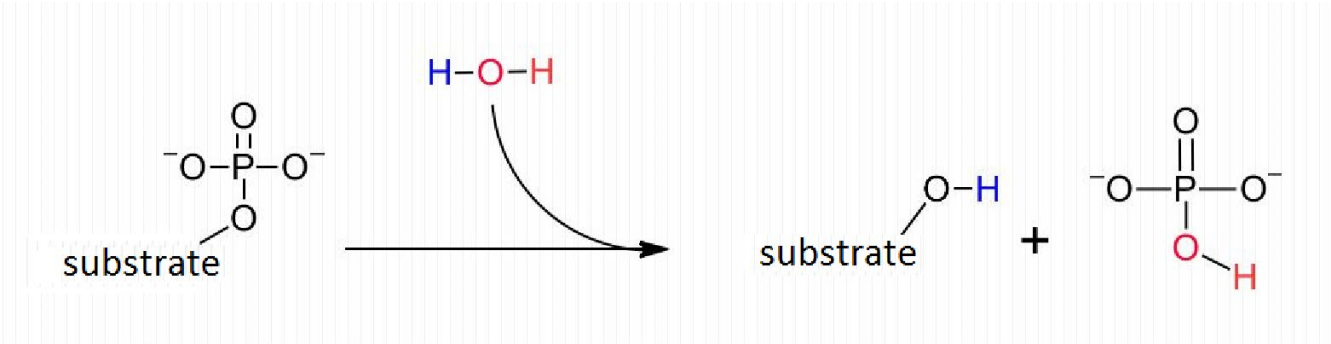
磷酸化酶

kinase

激酶

phosphatase

磷酸酶



phosphorylase

磷酸化酶

kinase

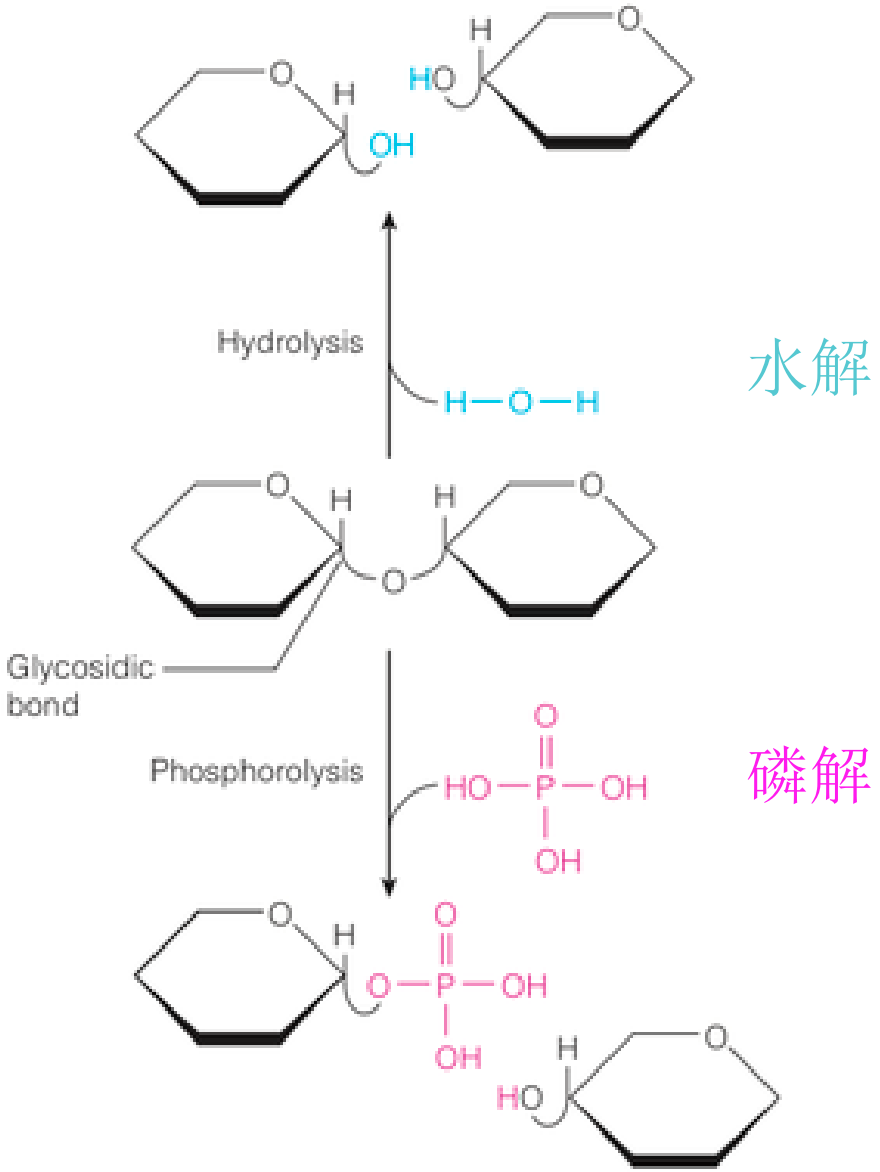
激酶

phosphatase

磷酸酶

phosphorylase

磷酸化酶

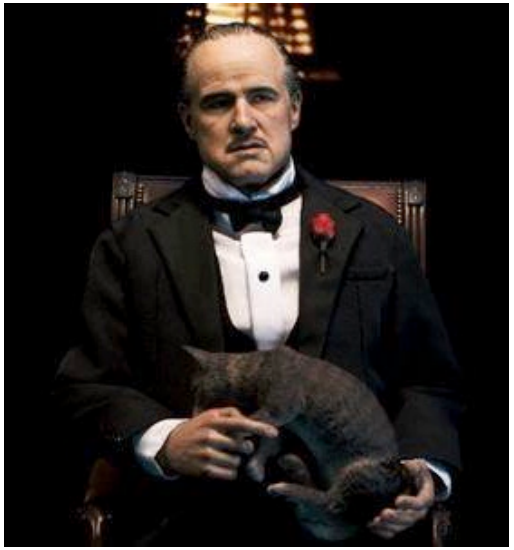


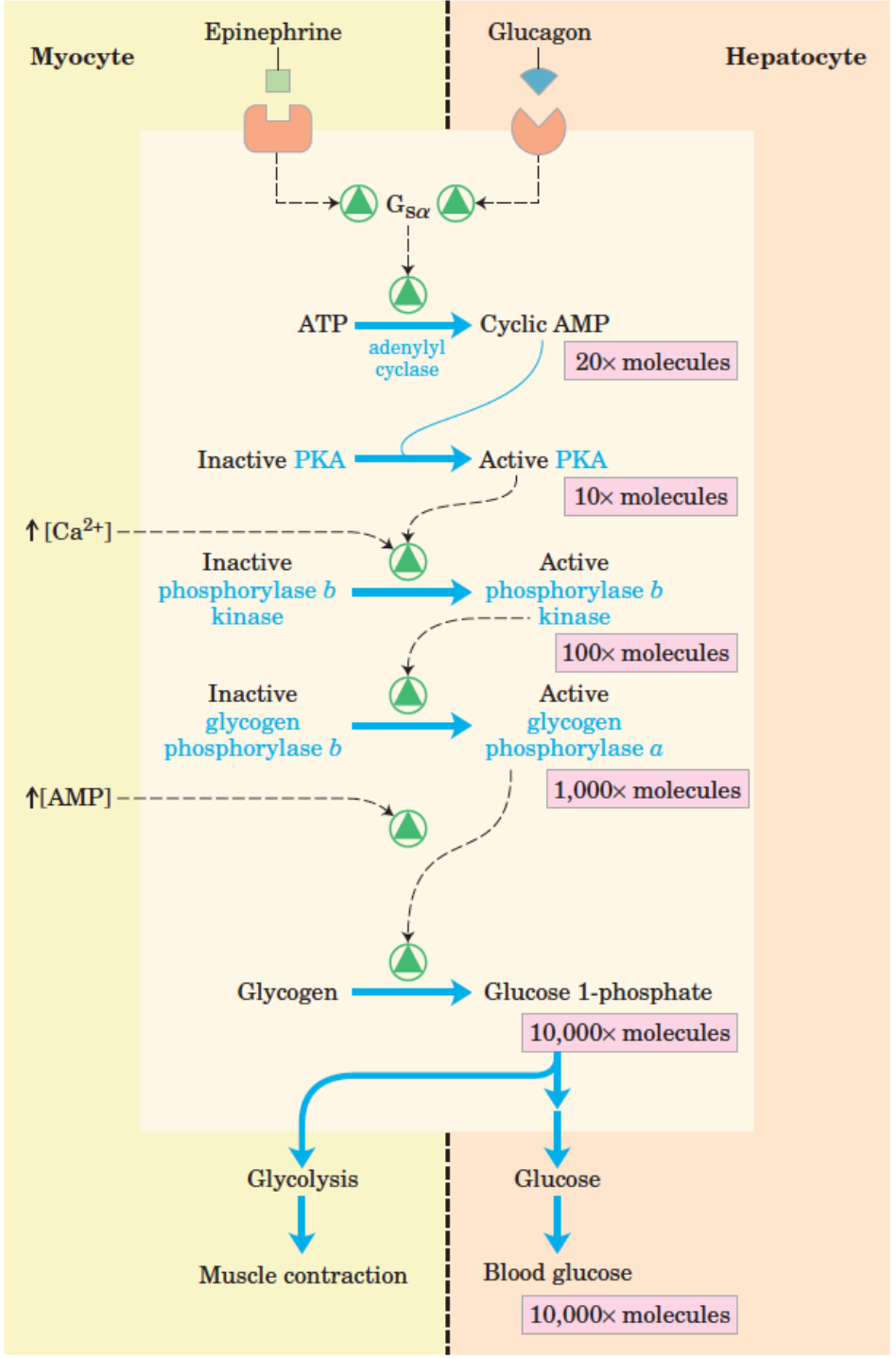
水解

磷解

Cascade amplification

级联放大





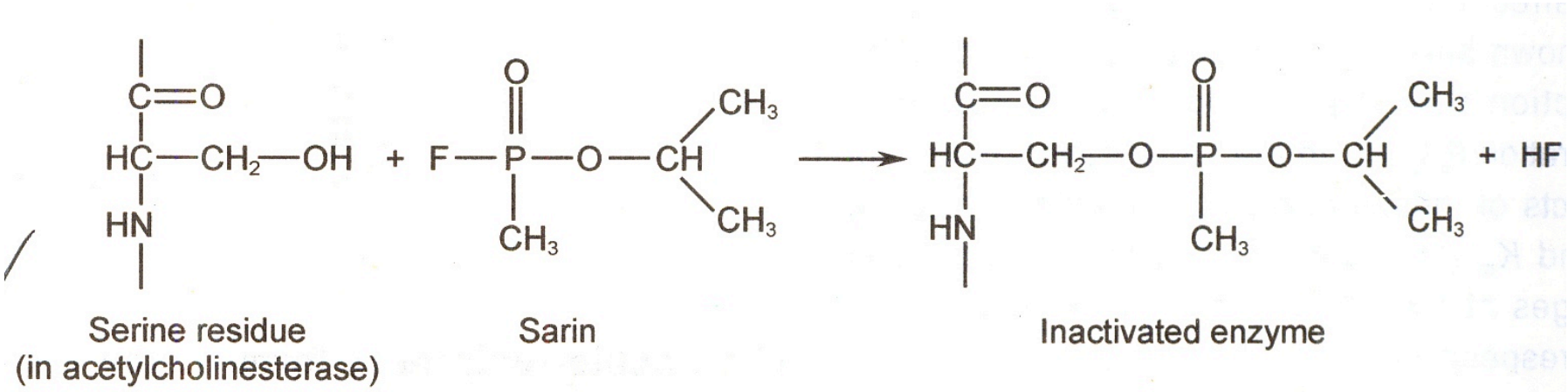
The Nobel Prize in Physiology or Medicine 1992

"for their discoveries concerning reversible protein phosphorylation as a biological regulatory mechanism"

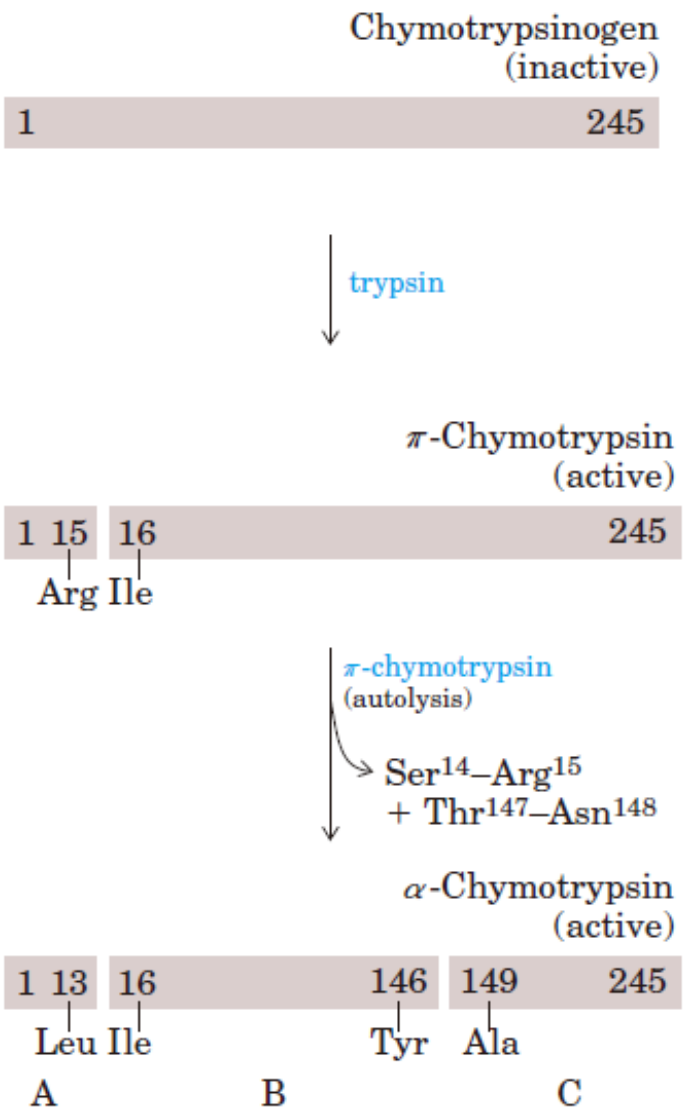
Edmond H. Fischer
University of Washington
Seattle, WA, USA
b. 1920 (in Shanghai)

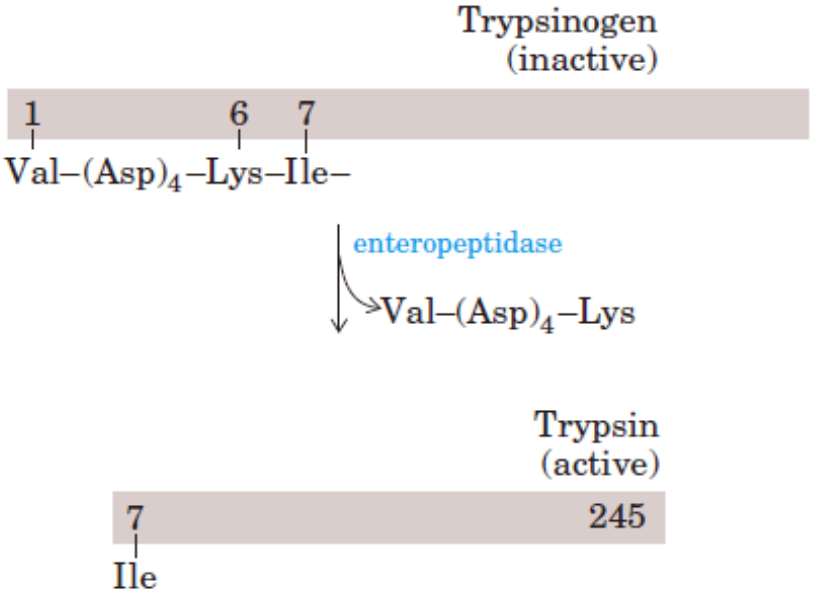
Edwin G. Krebs
University of Washington
Seattle, WA, USA
(1918 – 2009)

Irreversible inhibitor

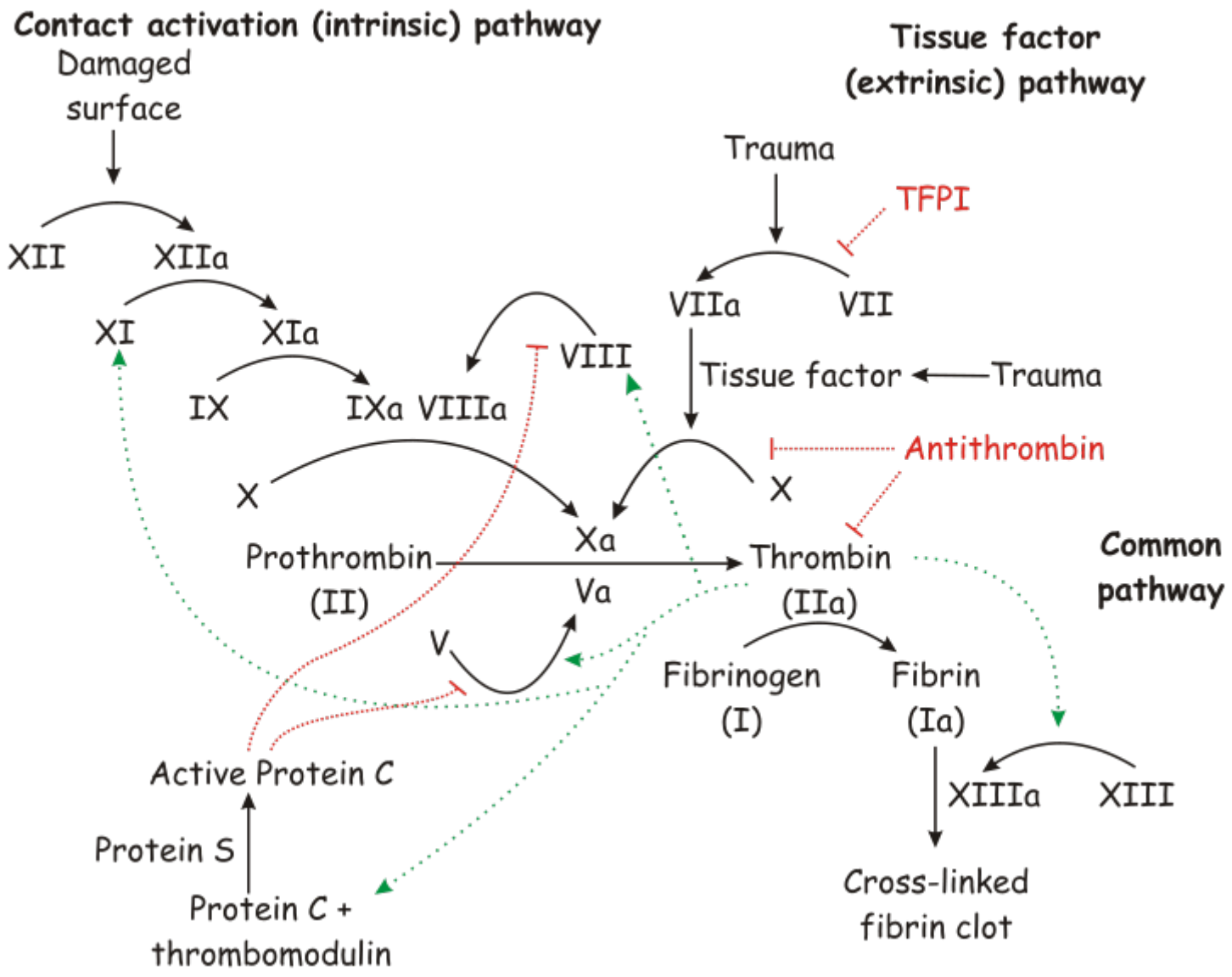


Activation of zymogen by proteolytic cleavage





Blood coagulation cascade 凝血体系



Next time: carbohydrates