Rate in = k(y)

Rate in = complicated function feedback

Rate in = increase, y \rightarrow increase Rate in \rightarrow increase y, autocatalytic feedback

Rate in saturates as y increases (membrane transport proteins can only be produced at some maximal rate)

\[ \text{Rate in} = k \left( y_0 + \frac{y^3}{y^3 + K} \right) \]

\[ \lambda = \text{extracellular factor} \]

Elementary reaction much more complicated than Michaelis–Menten example.

Chemicals involved: lactose, DNA, repressor, mRNA, RNA polymerase, amino acids (to build membrane transport proteins)

A different approach: Instead of deriving "Rate in" curve, just look mathematically for some simple function of y that has the right shape of curve

\[ \frac{dy}{dt} = \text{Rate in} - \text{Rate out} = ky - \lambda \left( k_0 + \frac{y^3}{y^3 + K} \right) \]

\[ \lambda = \text{small} \]

"Low" \lambda

\[ \frac{dy}{dt} = \text{Rate in} = \lambda \left( k_0 + \frac{y^3}{y^3 + K} \right) \]

Equilibrium: \[ f(y) = 0 \Rightarrow f_1(y) = f_2(y) \]

\[ \frac{3y^2(y^3 + 5) - y^4(3y^2)}{(y^3 + 5)^2} = \frac{15y^5}{(y^3 + 5)^2} \]

\[ y^* > 0 \text{ stable, small value.} \]