$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

$$H_2O_2 + I^- \longrightarrow OI^- + H_2O$$

$$H_2O_2 + OI^- \longrightarrow I^- + H_2O$$

$$\frac{d[I^-]}{dt} = -k_1[I^-][H_2O_2] + k_2[OI^-][H_2O_2]$$

$$\frac{d[OI^-]}{dt} = -\frac{d[I^-]}{dt}$$

$$[I^-]_0 = [I^-] + [OI^-]$$

$$\text{rate} = \frac{1}{2}\frac{d[H_2O]}{dt} = \frac{1}{2}\left[k_1[H_2O_2][I^-] + k_2[H_2O_2][OI^-]\right]$$

$$\text{SS} \qquad k_2[OI^-] = k_1[I^-]$$

$$\text{rate} = k_1[H_2O_2][I^-]$$

$$[I^-]_0 = [I^-]\left[1 + \frac{k_1}{k_2}\right] = [I^-]\left(\frac{k_2+k_1}{k_2}\right)$$

$$\text{rate} = k_1\left(1+\frac{k_1}{k_2}\right)^{-1}[I^-]_0[H_2O_2] = \left(\frac{k_1k_2}{k_1+k_2}\right)[I^-][H_2O_2]$$

AUTOCATALYSIS

$$A + B \longrightarrow T$$
$$A + B + T \longrightarrow T + T$$

chemical self replication

LV

$$R \cancel{+R} \longrightarrow R + R$$
$$W + R \longrightarrow W + W$$

Population Dynamics → Population can not grow faster than exponential

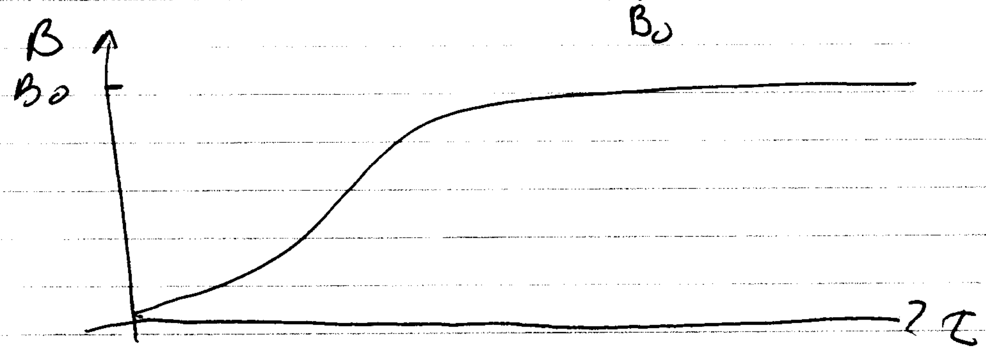
$$\Rightarrow \frac{dP}{dt} = k_r P$$

For example bacteria

$$\frac{dB}{dt} = k\left(1 - \frac{B}{B_0}\right)B \qquad \text{Logistic Eq.}$$

B_0 carrying capacity

$$= kB - \frac{k}{B_0}B^2$$



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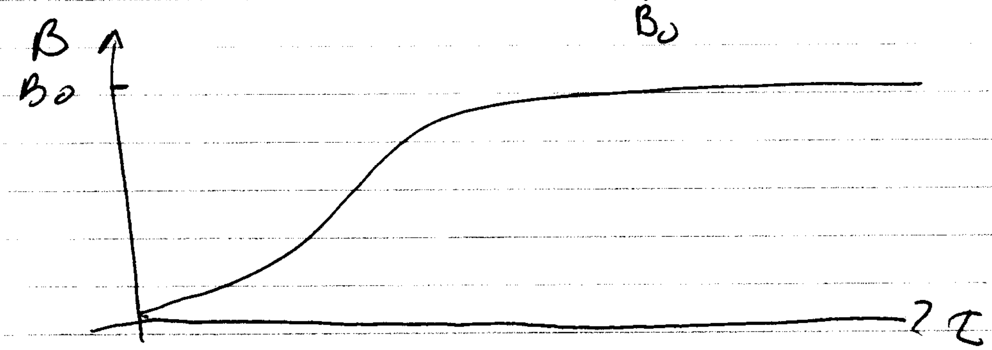

$$M + F \rightarrow \alpha(M+F) + M + F$$

$$\frac{dM}{dt} = \frac{kMW}{K+M+W} - k_d M$$

$$\frac{dW}{dt} = \frac{kMW}{K+M+W} - k_d W$$

$$\left.\begin{aligned} P &= M + W \\ D &= W - M \end{aligned}\right\} \quad \begin{aligned} M &= \tfrac{1}{2}(P+D) \\ W &= \tfrac{1}{2}(P-D) \end{aligned}$$

$$\frac{dP}{dt} = \frac{2k\,\frac{1}{4}(P^2-D^2)}{K+P} - k_d P$$

$$\frac{dD}{dt} = -k_d D \Rightarrow D(t) = D_0\, e^{-k_d t} \rightarrow 0$$

Old ~~LARGE~~ Population

$$\frac{dP}{dt} = \frac{k_r P^2}{K+P} - k_d P \rightarrow k_r P - k_d P$$

$$\boxed{\frac{dD}{dt} = kP}$$