

healthy cells

tumor cells

proliferation

carrying capacity limited

matrix limited

diffusion

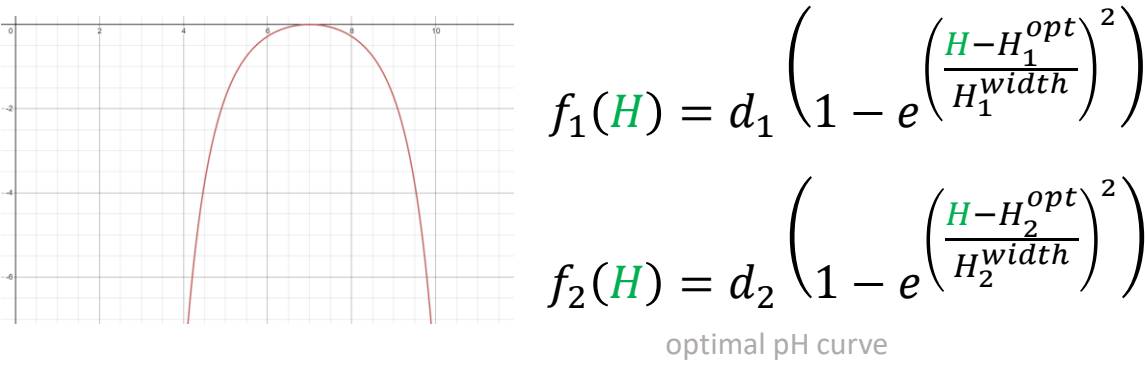
carrying capacity limited

matrix limited

slower growth/death from non-optimal pH

$$\frac{\partial N_1}{\partial t} = k_1 N_1 \left(1 - \frac{N_1}{\theta_1} - \frac{N_2}{\theta_2}\right) \left(1 - \frac{M}{M_o}\right) + \nabla \cdot \left(D_{N_1} \left(1 - \frac{N_1}{\theta_1} - \frac{N_2}{\theta_2}\right) \left(1 - \frac{M}{M_o}\right) \nabla N_1 \right) - f_1(H) N_1$$

$$\frac{\partial N_2}{\partial t} = k_2 N_2 \left(1 - \frac{N_1}{\theta_1} - \frac{N_2}{\theta_2}\right) \left(1 - \frac{M}{M_o}\right) + \nabla \cdot \left(D_{N_2} \left(1 - \frac{N_1}{\theta_1} - \frac{N_2}{\theta_2}\right) \left(1 - \frac{M}{M_o}\right) \nabla N_2 \right) - f_2(H) N_2$$



protons

bicarbonate treatment

diffusion

acid production by tumor cells

hydrogen uptake by surrounding tissue

acid-base neutralization

$$\frac{\partial H}{\partial t} = D_H \nabla^2 H + k_{acid} N_2 - d_H (H - H_0) - k_{neut} HB$$

$$\frac{\partial B}{\partial t} = D_B \nabla^2 B + \cancel{d_B} - k_{neut} HB$$

diffusion

bicarbonate introduction

acid-base neutralization

Use initial conditions to introduce B into system instead

generalized extracellular matrix

MMPs

matrix degradation by MMPs

MMP degradation

$$\frac{\partial M}{\partial t} = -f_{MMP}(H) P M$$

$$\frac{\partial P}{\partial t} = D_P \nabla^2 P + k_P N_2 - d_P P$$

diffusion

MMP production by tumor cells

