Basics of the black box model

Technology for Biobased Products

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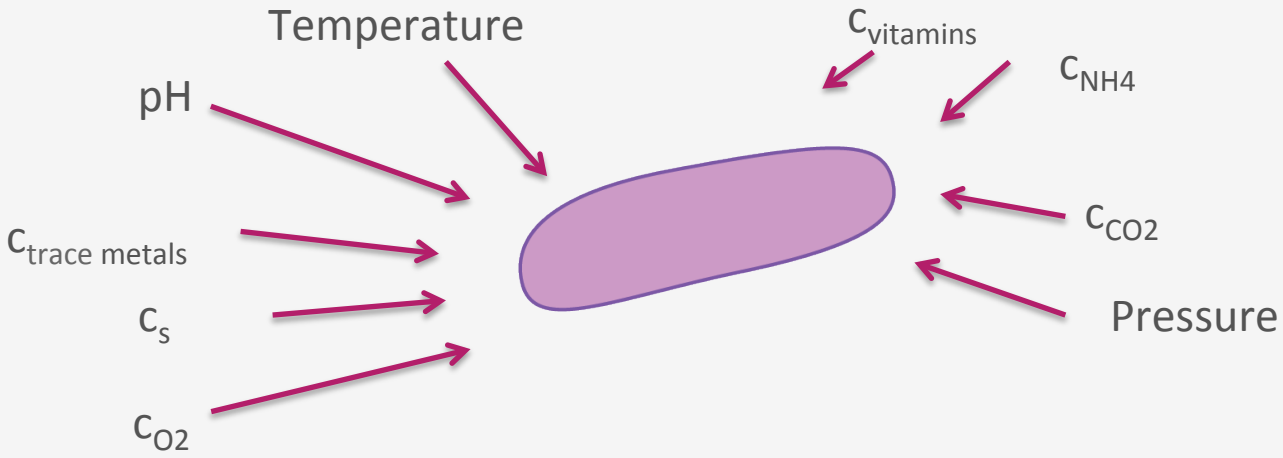
Process reaction for 1 mol PDO

$$\frac{q_s}{q_p} * C_6H_{12}O_6 + \frac{q_{NH_4^+}}{q_p} * NH_4^+ + \frac{q_{O_2}}{q_p} * O_2 + \frac{\mu}{q_p} * \underbrace{C_1H_{1.8}O_{0.5}N_{0.2}}_{\text{Biomass}} + 1 * \underbrace{C_3H_8O_2}_{\text{PDO}} + \frac{q_{CO_2}}{q_p} * CO_2 + \frac{q_{H_2O}}{q_p} * H_2O + \frac{q_{H^+}}{q_p} * H^+ + \frac{q_Q}{q_p}(heat)$$

q-rate values are needed

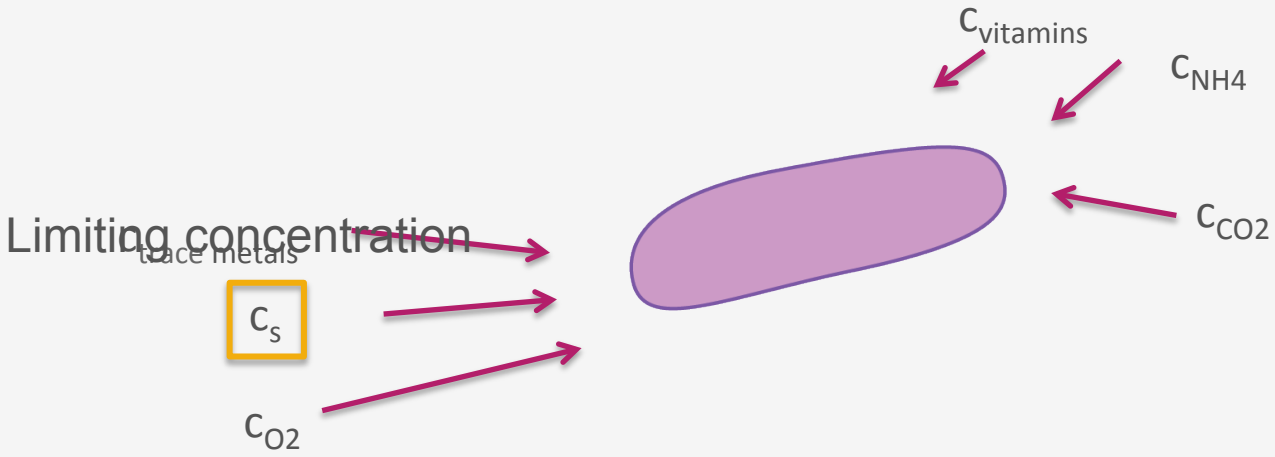
What determines q-rates?



q_i = function of (T, P, pH, c_s, c_{O2}, c_{CO2}, c_{NH4}, $c_{vitamins}$, $c_{trace\ metals}$, etc..)

Very complicated kinetics function for q_i

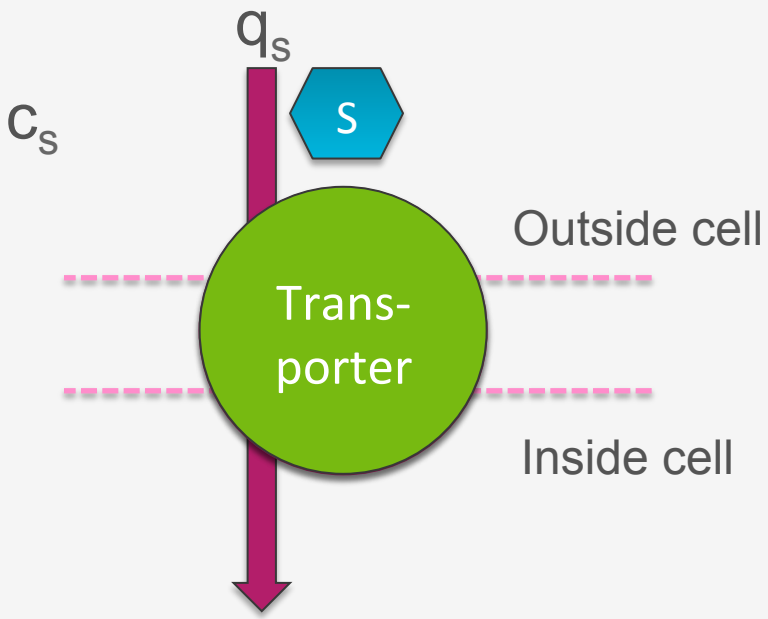
Trick: single nutrient limiting nutrient medium



q_i = function of (c_s, c_{O2}, c_{CO2}, c_{NH4}, $c_{vitamins}$, $c_{trace\ metals}$, etc...)

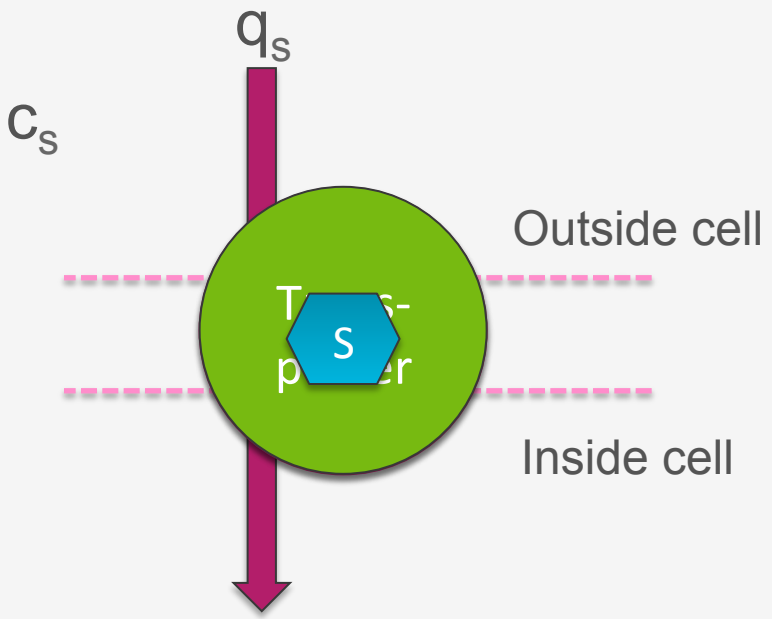
q_i only depends on c_s (at constant pH, T and pressure)

Basics of limiting nutrient concept



Empty transporter

Basics of limiting nutrient concept

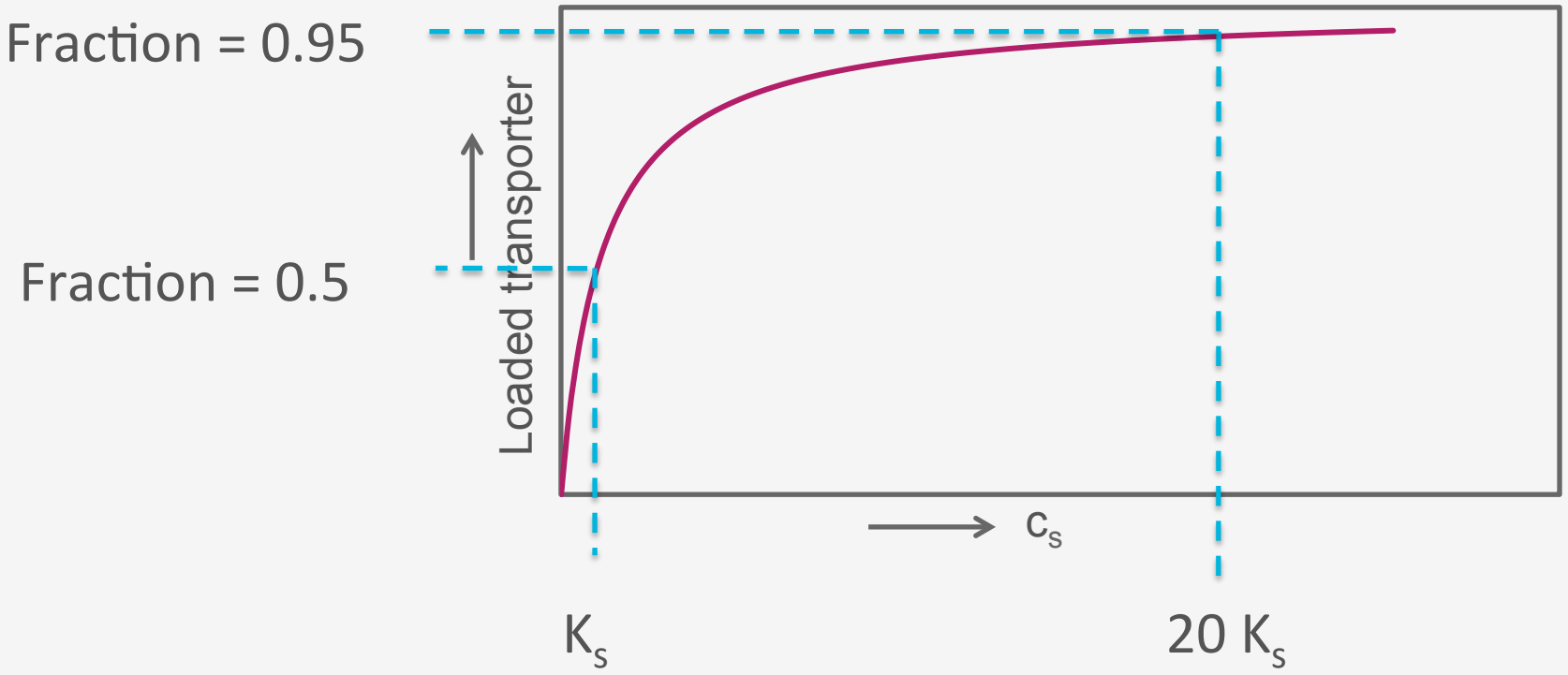


Loaded transporter

Fraction loaded transporter

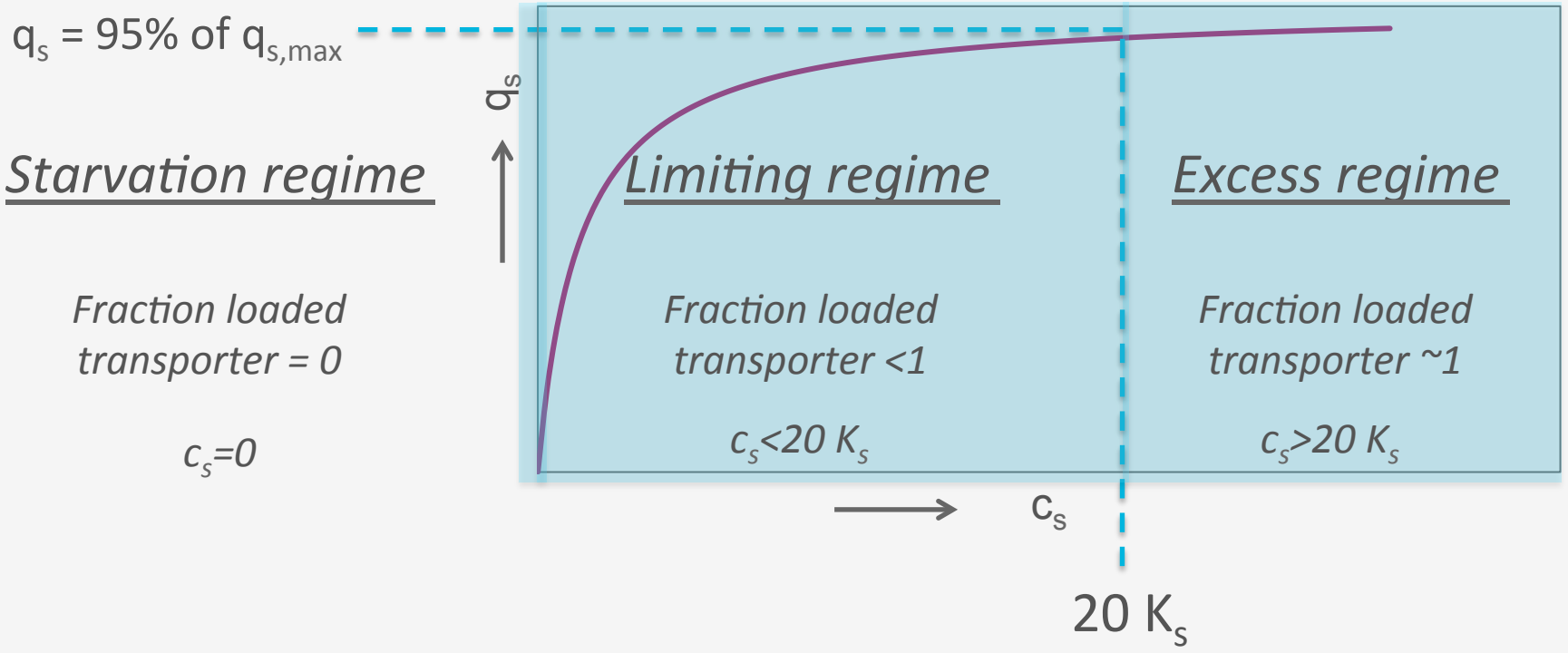
Hyberbolic dependence

$$Fraction = \frac{c_s}{K_s + c_s}$$

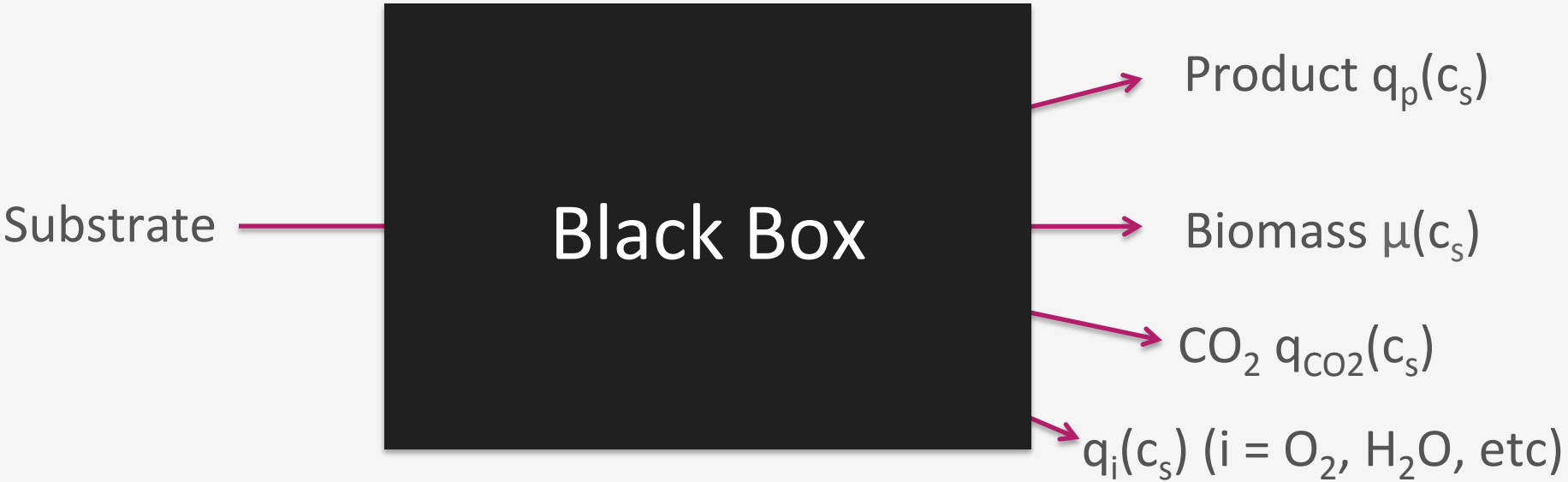


Hyperbolic q_s function

$$q_s = q_{s,\max} * \frac{c_s}{K_s + c_s}$$



Intracellular pseudo steady state: Flux coupling



- Short passage time (<1 minute)
- Low intracellular metabolite concentration (10^{-2} – 10^{-6} M)

See you in the next unit!