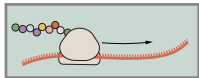


(A)

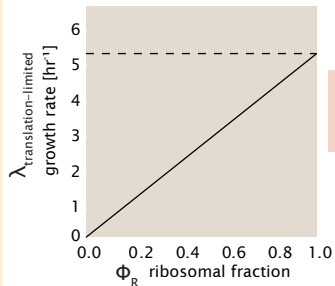
translation-limited growth rate



$$\lambda_{\text{translation-limited}} = \frac{\ln(2) \times r_t \times R}{N_{\text{aa}}}$$

$$N_{\text{aa}} \approx m_{\text{protein}} \times \frac{1 \text{ aa}}{110 \text{ Da}} \times \frac{6 \times 10^{11} \text{ Da}}{1 \text{ pg}}, \quad \phi_R = \frac{m_R}{m_{\text{protein}}}$$

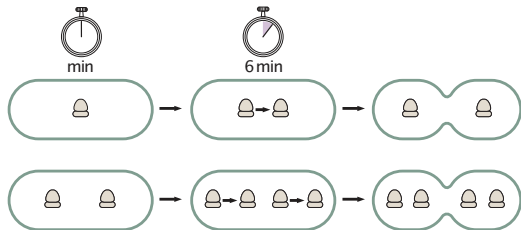
$$R \approx m_R \times \frac{1 \text{ ribosome}}{L_R \times 110 \text{ Da}} \times \frac{6 \times 10^{11} \text{ Da}}{1 \text{ pg}}$$



$$\lambda_{\text{translation-limited}} \approx \frac{\ln(2) \times r_t}{L_R} \phi_R$$

(B)

maximum growth rate is set by ribosome



(C)

maintenance of steady-state growth

$$r_t \times R \leq r_t^{\text{max}} \times R$$

nutrient-rich:

$$v > r_t \times R$$



$$r_t \times R \approx r_t^{\text{max}} \times R$$

nutrient-limited:

$$v < r_t \times R$$



$$r_t < r_t^{\text{max}}$$

$$R_{\text{act}} < R$$