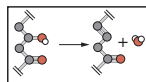


CELL ENVELOPE BIOSYNTHESIS

(A)

lipid synthesis



$$A_{\text{surface}} \approx 5 \mu\text{m}^2 \quad \text{BNID: 101792}$$

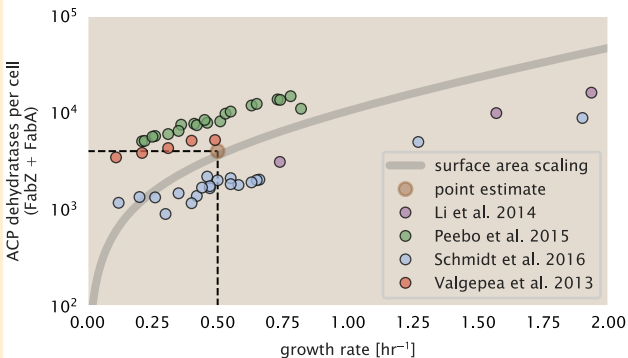
$$A_{\text{lipid}} \approx 0.5 \text{ nm}^2 \quad \text{BNID: 106993}$$

$$A_{\text{surface}}^{(\text{lipid})} \approx 40\% \quad \text{BNID: 100078}$$

$$N_{\text{lipids}} \approx \frac{4 \text{ leaflets}}{1 \text{ cell}} \times \frac{0.4 \times 5 \mu\text{m}^2}{1 \text{ leaflet}} \times \frac{1 \text{ lipid}}{0.5 \text{ nm}^2} \times \frac{10^6 \text{ nm}^2}{1 \mu\text{m}^2} \approx 2 \times 10^7 \text{ lipids / cell}$$

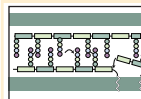
$$r_{\text{ACP dehydratase}} \approx 1 \text{ lipid / sec} \quad \text{Ruppe \& Fox 2018; Fiers et al. 2016; Heath et al. 1996}$$

$$N_{\text{ACP dehydratases}} \approx \frac{2 \times 10^7 \text{ lipids}}{1 \text{ cell}} \times \frac{1 \text{ sec} \times \text{enzyme}}{1 \text{ lipid}} \times \frac{1 \text{ cell}}{5000 \text{ sec}} \approx 4000 \text{ ACP dehydratases}$$



(B)

peptidoglycan synthesis



$$m_{\text{peptidoglycan}} \approx 0.03 \times m_{\text{dry}} \approx 10 \text{ fg} \quad \text{BNID: 101936}$$

$$m_{\text{amino acid}} \approx 110 \text{ Da} \quad \text{BNID: 104877}$$

$$m_{\text{murein sugar}} \approx 250 \text{ Da} \quad \text{average molecular weight GlcNAc and NAMA}$$

$$m_{\text{monomer}} \approx 5 \times m_{\text{amino acid}} + 2 \times m_{\text{murein sugar}} \approx 1000 \text{ Da}$$

$$N_{\text{monomer}} \approx \frac{10 \text{ fg}}{1 \text{ cell wall}} \times \frac{1 \text{ monomer}}{1000 \text{ Da}} \times \frac{5 \times 10^8 \text{ Da}}{1 \text{ fg}} \approx \frac{5 \times 10^6 \text{ monomers}}{\text{cell wall}}$$

$$N_{\text{crosslinks}} \approx 0.2 \times N_{\text{murein monomers}} \approx 10^6 \text{ crosslinks} \quad \text{Vollmer et al. 2008; Rogers et al. 1980}$$

$$r_{\text{transpeptidase}} \approx 2 \text{ crosslinks / sec} \quad \text{Catherwood et al. 2020}$$

$$N_{\text{transpeptidases}} \approx \frac{10^6 \text{ crosslinks}}{1 \text{ cell}} \times \frac{1 \text{ sec} \times \text{enzyme}}{2 \text{ crosslinks}} \times \frac{1 \text{ cell}}{5000 \text{ sec}} \approx 100 \text{ transpeptidases}$$

