(A) (B) lipid synthesis peptidoglycan synthesis $A_{\text{number}} \approx 5 \ \mu\text{m}^2$ BNID: 101792 $m_{\text{nentidoglycan}} \approx 0.03 \times m_{\text{dry}} \approx 10 \text{ fg}$ BNID: 101936 m_{amino acid} ≈ 110 Da BNID: 104877 ... ≈ 0.5 nm² BNID: 106993 m____ ≈ 250 Da average molecular weight GlcNac and NAMA BNID: 100078 $m_{monomer} \approx 5 \times m_{amino acid} + 2 \times m_{murain sugar} \approx 1000 Da$ $N_{\text{lipids}} \approx \frac{4 \text{ leaflets}}{1 \text{ cell}} \times \frac{0.4 \times 5 \ \mu\text{m}^2}{1 \text{ leaflet}} \times \frac{1 \text{ lipid}}{0.5 \text{ nm}^2} \times \frac{10^6 \text{ nm}^2}{1 \text{ lim}^2} \sim 2 \times 10^7 \text{ lipids / cell}$ $N_{monomer} \approx \frac{10 \text{ fg}}{1 \text{ cell wall}} \times \frac{1 \text{ monomer}}{1000 \text{ Da}} \times \frac{5 \times 10^8 \text{Da}}{1 \text{ fg}} \approx \frac{5 \times 10^6 \text{ monomers}}{\text{cell wall}}$ $N_{crosslinks} \approx 0.2 \times N_{mursin monomers} \sim 10^6 \, crosslinks$ Vollmer et al. 2008; Rogers et al. 1980 r_{ACP debudratase} \approx 1 lipid / sec Ruppe & Fox 2018; Fiers et al. 2016; Heath et al. 1996 r_{transpentidase} ≈ 2 crosslinks / sec Catherwood et al. 2020 $\frac{2\times10^7 \text{ lipids}}{1 \text{ cell}} \times \frac{1 \text{ sec} \times \text{enzyme}}{1 \text{ lipid}} \times \frac{1 \text{ cell}}{5000 \text{ sec}} \approx 4000 \text{ ACP dehydratases}$ $\frac{10^6 \text{ crosslinks}}{1 \text{ cell}} \times \frac{1 \text{ secxenzyme}}{2 \text{ crosslinks}} \times \frac{1 \text{ cell}}{5000 \text{ sec}} \approx 100 \text{ transpeptidases}$ 105 surface area scaling Peebo et al. 2015 O Schmidt et al. 2016 point estimate Li et al. 2014 Valgepea et al. 2013

CELL ENIVELOPE RIOSYNTHESIS

