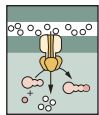


(A)

## ATP synthesis

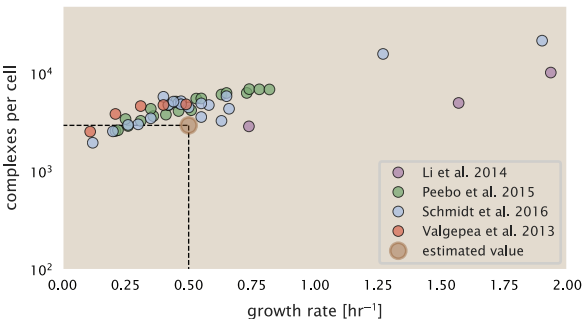


$$N_{\text{peptide bonds}} \approx 3 \times 10^6 \text{ proteins} \times \frac{300 \text{ peptide bonds}}{1 \text{ protein}} \approx 10^9 \text{ peptide bonds}$$

$$N_{\text{ATP}} \approx \frac{4 \text{ ATP}}{\text{peptide bond}} \times 10^9 \text{ peptide bonds} \approx 4 \times 10^9 \text{ ATP}$$

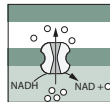
$$r_{\text{ATP synthesis}} \approx \frac{300 \text{ ATP / sec}}{\text{synthase}} \quad \text{BNID: 114701}$$

$$N_{\text{ATP synthases}} \approx \frac{4 \times 10^9 \text{ ATP}}{1 \text{ cell}} \times \frac{1 \text{ sec}}{300 \text{ ATP}} \times \frac{1 \text{ cell}}{6000 \text{ sec}} \approx 3000 \text{ synthases}$$



(B)

## maintenance of proton gradient



$$r_{\text{proton use for ATP synthesis}} \approx N_{\text{ATP synthases}} \times \frac{300 \text{ ATP}}{1 \text{ sec}} \times \frac{4 \text{ protons}}{1 \text{ ATP}} \approx 4 \times 10^6 \frac{\text{protons}}{\text{sec}}$$

$$r_{\text{proton transport}} \approx 5000 \frac{\text{protons / sec}}{\text{electron transport complex}} \quad \text{BNID: 114704, BNID: 114687}$$

$$N_{\text{electron transport complexes}} \approx \frac{4 \times 10^6 \text{ protons}}{1 \text{ sec}} \times \frac{1 \text{ sec}}{5000 \text{ protons}} \approx 10^3 \text{ complexes}$$

