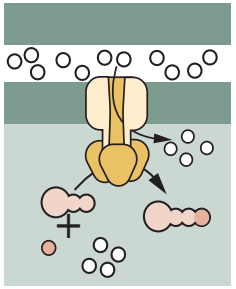
ATP synthesis



$N_{proteins} \approx 3 \times 10^6$ BNID: 115702 — number of proteins per cell

$N^{(protein)}_{amino\ acids} \approx 300$ amino acids / protein BNID: 100017 — average number of amino acids per protein

$N^{(amino\ acid)}_{peptide\ bond} \approx 1$

$$N^{(cell)}_{peptide\ bond} \approx \frac{N_{proteins} \times N^{(protein)}_{amino\ acids}}{N^{(amino\ acid)}_{peptide\ bond}} \approx \frac{3 \times 10^6 \frac{proteins}{cell} \times 300 \frac{amino\ acids}{protein}}{1 \frac{peptide\ bond}{amino\ acid}}$$

$\approx 1 \times 10^9$ peptide bonds — number of peptide bonds required to double proteins

$N^{(peptide\ bond)}_{ATP} \approx 4$ ATP / peptide bond BNID: 101442 — ATP to generate peptide bond

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

$$N_{ATP\ synthases} \approx \frac{N^{(peptide\ bond)}_{ATP} \times N^{(cell)}_{peptide\ bond}}{r_{ATP\ synthesis} \times t_{division}} \approx \frac{4 \frac{ATP}{peptide\ bond} \times 10^9 \frac{peptide\ bonds}{cell}}{300 \frac{ATP}{sec \times synthase} \times 5000 \frac{sec}{cell}}$$

≈ 3000 ATP synthases — number of ATP synthase complexes