ATP synthesis

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

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

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

$N_{peptide\ bond}^{(cell)} \approx \dfrac{N_{proteins} \times N_{amino\ acids}^{(protein)}}{N_{peptide\ bond}^{(amino\ acid)}} \approx \dfrac{3 \times 10^6\ \frac{proteins}{cell} \times 300\ \frac{amino\ acids}{protein}}{1\ \frac{peptide\ bond}{amino\ acid}}$ — number of peptide bonds required to double proteins

$\approx 1 \times 10^9$ peptide bonds

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

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

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

≈ 3000 ATP synthases