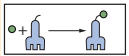
(A)

tRNA charging

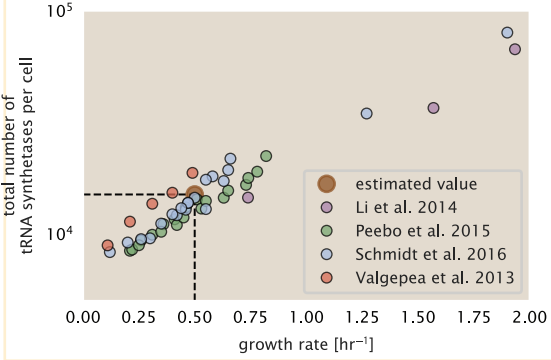


$N_{amino\text{-}acyl\ tRNA} \approx 3 \times 10^6$ proteins $\times \frac{300\ amino\ acids}{1\ protein}$

$\approx 10^9$ amino-acyl tRNAs

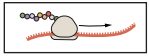
$r_{tRNA\ charging} \approx 10$ amino-acyl tRNA / sec BNID: 104980

$$N_{tRNA\ synthetase} \approx \frac{N_{amino\text{-}acyl\ tRNA}}{r_{tRNA\ charging} \times t_{division}} \approx 2 \times 10^4\ \text{tRNA synthetases}$$



(B)

translation



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

$\approx 10^9$ peptide bonds

$r_{translation} \approx 15$ peptide bonds / sec BNID: 109043

$$N_{ribosomes} \approx \frac{N_{peptide\ bonds}}{r_{translation} \times t_{division}} \approx 10^4\ \text{ribosomes}$$