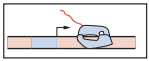
RNA SYNTHESIS

(A)



$r_{transcription} \approx 40$ nucleotides / sec BNID: 111871

rRNA synthesis

$L_{rRNA\ genes} \approx 4500$ nucleotides BNID: 108093

$r_{RNAP\ loading} \approx 1$ / sec BNID: 111997

$L_{RNAP\ footprint} \approx 40$ nucleotides BNID: 107873

$$\rho_{RNAP} \approx \frac{1\ \text{RNAP}}{L_{RNAP\ footprint} + \frac{r_{transcription}}{r_{RNAP\ loading}}} \approx \frac{1\ \text{RNAP}}{80\ \text{nucleotides}}$$

$$N_{RNAP}^{(rRNA)} \approx L_{rRNA\ genes} \times N_{rRNA\ genes} \times \rho_{RNAP} \approx 400\ \text{RNAP}$$

mRNA synthesis

BNID: 104186;106254

$$N_{mRNA} \approx \frac{1\ \text{mRNA}}{1000\ \text{proteins}} \times 3 \times 10^6\ \text{proteins}$$

≈ 3000 mRNA (at steady state)

$r_{degradation} \approx 1$ mRNA / 300 s BNID:111927

$L_{mRNA} \approx 1000$ nucleotides BNID:100022

$$N_{RNAP}^{(mRNA)} \approx \frac{N_{mRNA} \times r_{degradation} \times L_{mRNA}}{r_{transcription}} \approx 250\ \text{RNAP}$$

tRNA synthesis

BNID: 105280

$$N_{tRNA} \approx \frac{3000}{\text{amino acid}} \times 20\ \text{amino acids}$$

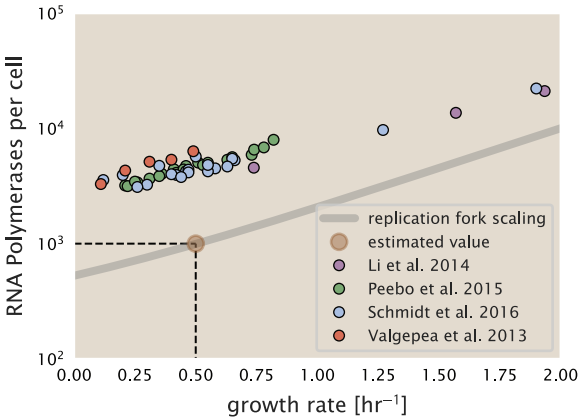
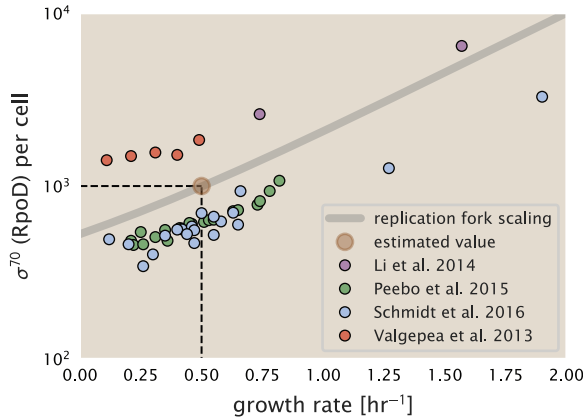
$\approx 6 \times 10^4$ tRNA

$L_{tRNA} \approx 80$ nucleotides BNID:102340

$$N_{RNAP}^{(tRNA)} \approx \frac{N_{tRNA} \times L_{tRNA}}{r_{transcription} \times t_{division}} \approx 20\ \text{RNAP}$$

$$N_{RNAP} \approx N_{RNAP}^{(rRNA)} + N_{RNAP}^{(mRNA)} + N_{RNAP}^{(tRNA)} \approx 700\ \text{RNAP}$$

(B)



(C)