

**TABLE 2.1** Typical Parameter Values for the Bacterial *E. coli* Cell, the Single-Celled Eukaryote *Saccharomyces cerevisiae* (Yeast), and a Mammalian Cell (Human Fibroblast)

Property	<i>E. coli</i>	Yeast ( <i>S. cerevisiae</i> )	Mammalian (Human Fibroblast)
Cell volume	~1 $\mu\text{m}^3$	~1000 $\mu\text{m}^3$	~10,000 $\mu\text{m}^3$
Proteins/cell	4 $10^6$	~4 $10^9$	~4 $10^{10}$
Mean size of protein	5 nm		
Size of genome	4.6 $10^6$ bp 4500 genes	1.3 $10^7$ bp 6600 genes	3 $10^9$ bp ~30,000 genes
Size of: Regulator binding site	~10 bp	~10 bp	~10 bp
Promoter	~100 bp	~1000 bp	~ $10^4$ to $10^5$ bp
Gene	~1000 bp	~1000 bp	~ $10^4$ to $10^6$ bp (with introns)
Concentration of one protein/cell	~1 nM	~1 pM	~0.1 pM
Diffusion time of protein across cell	~0.1 sec D = 10 $\mu\text{m}^2/\text{sec}$	~10 sec	~100 sec
Diffusion time of small molecule across cell	~1 msec, D = 1000 $\mu\text{m}^2/\text{sec}$	~10 msec	~0.1 sec
Time to transcribe a gene	~1 min 80 bp/sec	~1 min	~30 min (including mRNA processing)
Time to translate a protein	~2 min 40 aa/sec	~2 min	~30 min (including mRNA nuclear export)
Typical mRNA lifetime	2–5 min	~10 min to over 1 h	~10 min to over 10 h
Cell generation time	~30 min (rich medium) to several hours	~2 h (rich medium) to several hours	20 h — nondividing
Ribosomes/cell	~ $10^4$	~ $10^7$	~ $10^8$
Transitions between protein states (active/inactive)	1–100 $\mu\text{sec}$	1–100 $\mu\text{sec}$	1–100 $\mu\text{sec}$
Timescale for equilibrium binding of small molecule to protein (diffusion limited)	~1 msec (1 $\mu\text{M}$ affinity)	~1 sec (1 nM affinity)	~1 sec (1 nM affinity)
Timescale of transcription factor binding to DNA site	~1 sec		
Mutation rate	~ $10^{-9}$ /bp/generation	~ $10^{-10}$ /bp/generation	~ $10^{-8}$ /bp/year

bp: base-pair (DNA letter).