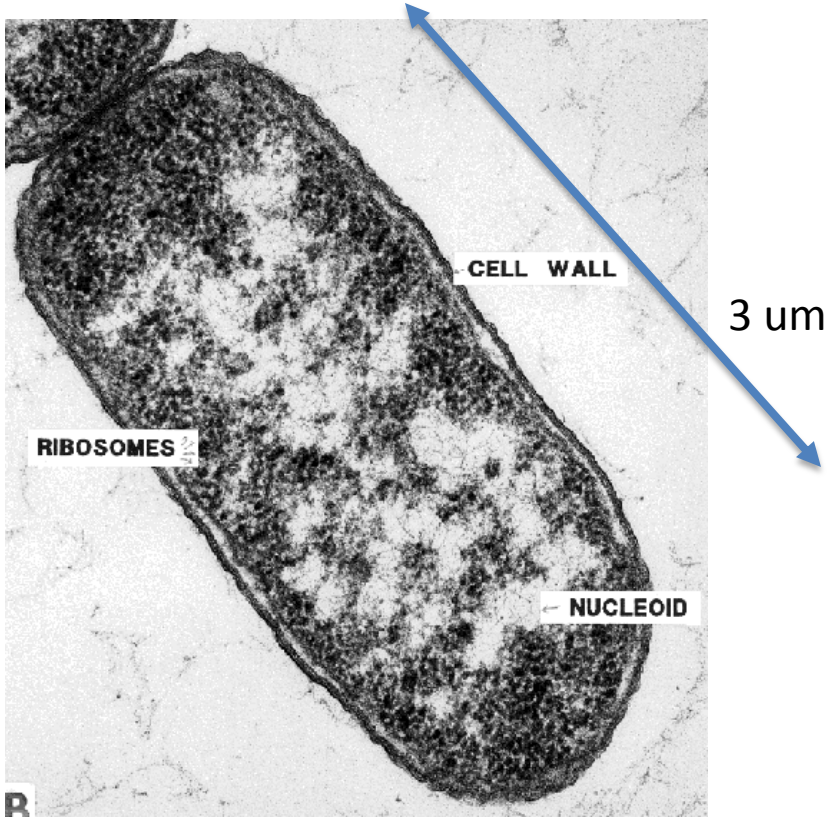
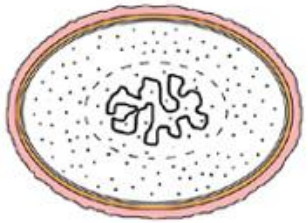
Prokaryotic Cells



1 .Bacteria lack membrane bound nuclei
2. DNA is circular
3. No complex internal organelles

http://www.ucmp.berkeley.edu/bacteria/bacteriamm.html

Comparison to Eukaryotic Cells

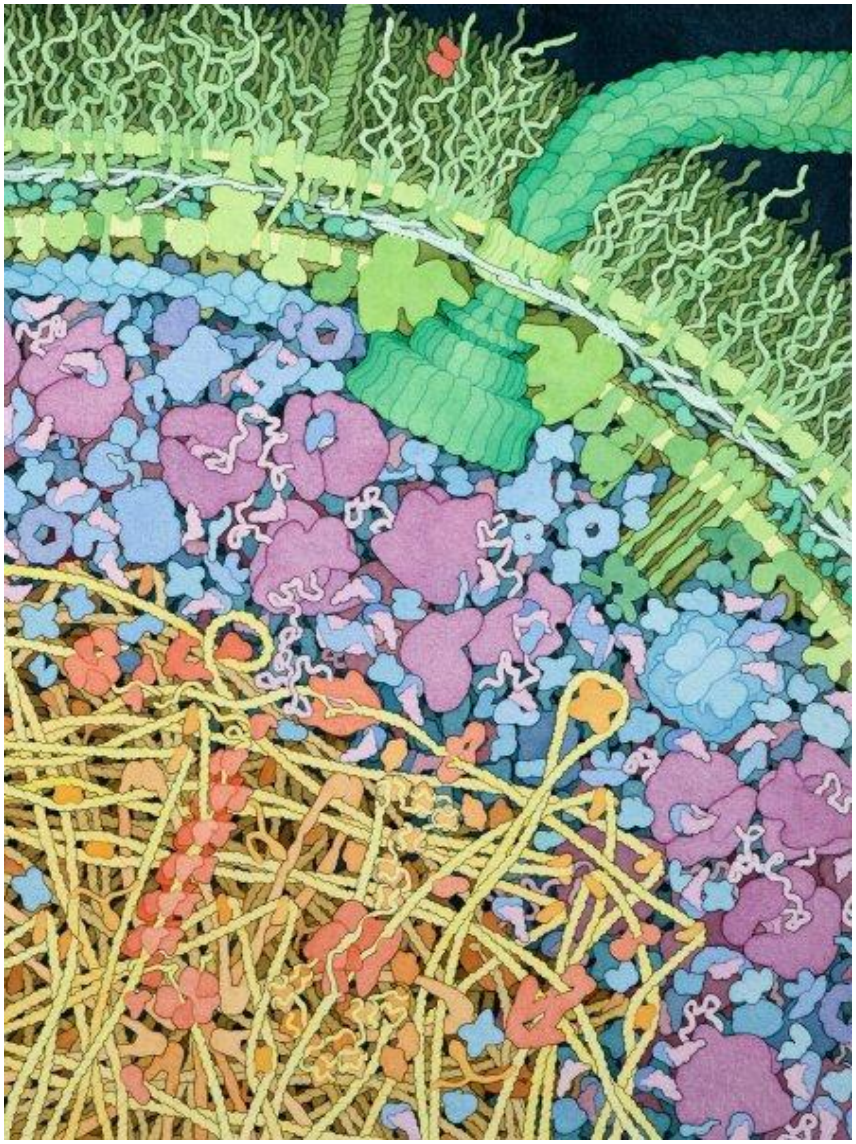


Prokaryotic Cell

Animal (Eukaryotic) Cell

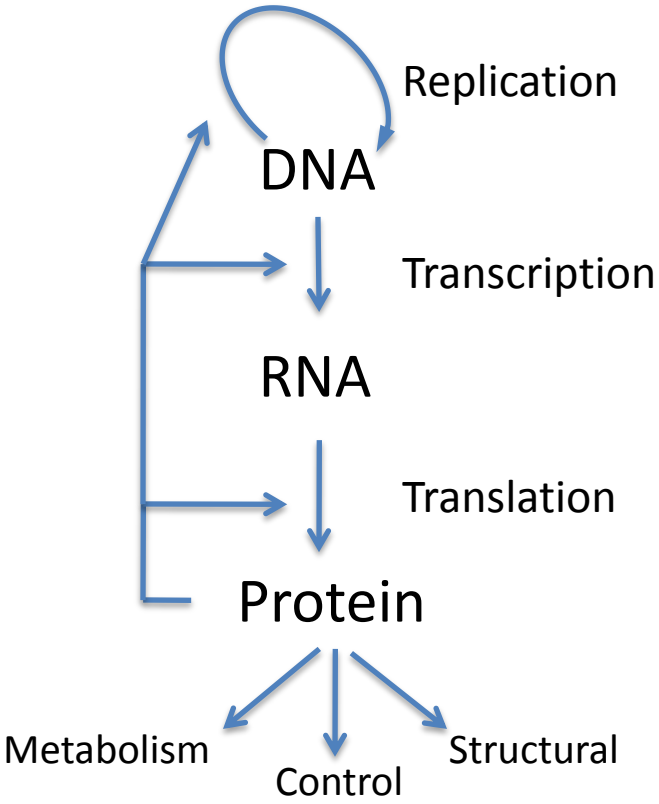
http://www.cod.edu/people/faculty/fancher/ProkEuk.htm

Biochemistry



Average spacing between proteins:
7 nm/molecule

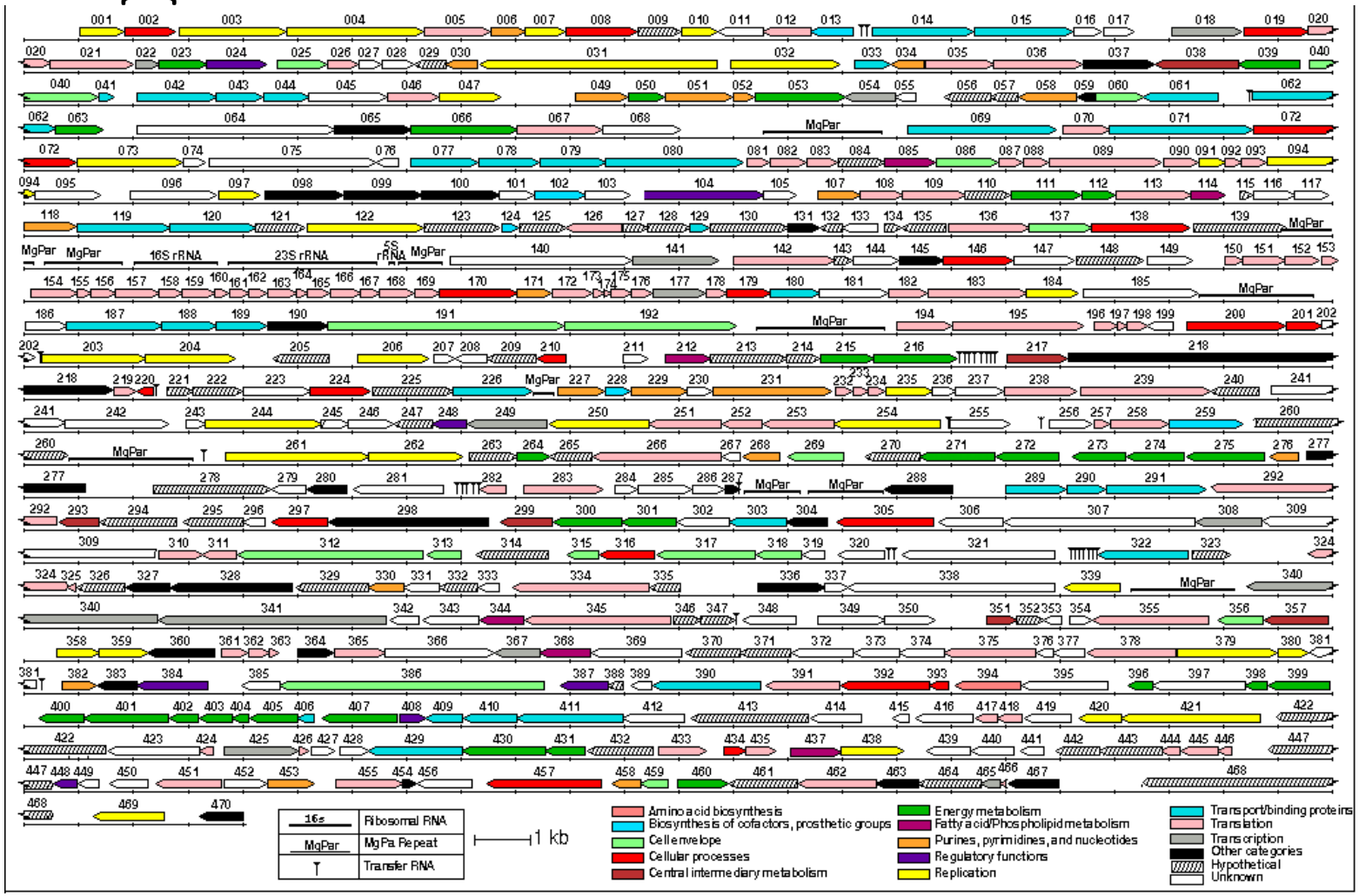
Diameter of a protein: 5 nm



David S. Goodsell (Scripps)

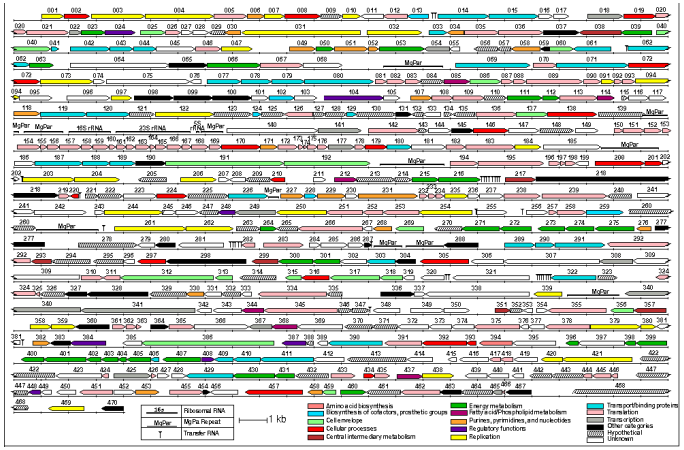
Single Gene

Smallest Genome – was in 1999



One of the smallest Genomes: Mycoplasma genitalium (Small parasitic bacterium)

Smallest Genome



Total genes:	521
Protein coding genes:	482
tRNA and rRNA:	39

This genome is of interest to synthetic biology because Craig Venter wants to use this organism as the basis for a minimal organism for genetic engineering.

Venter's group has removed roughly 101 genes and the organism is still viable, the idea then is to patent the minimal set of genes required for life.

Essential genes of a minimal bacterium

John I. Glass, Nacyra Assad-Garcia, Nina Alperovich, Shibu Yooseph, Matthew R. Lewis, Mahir Maruf, Clyde A. Hutchison III, Hamilton O. Smith*, and J. Craig Venter

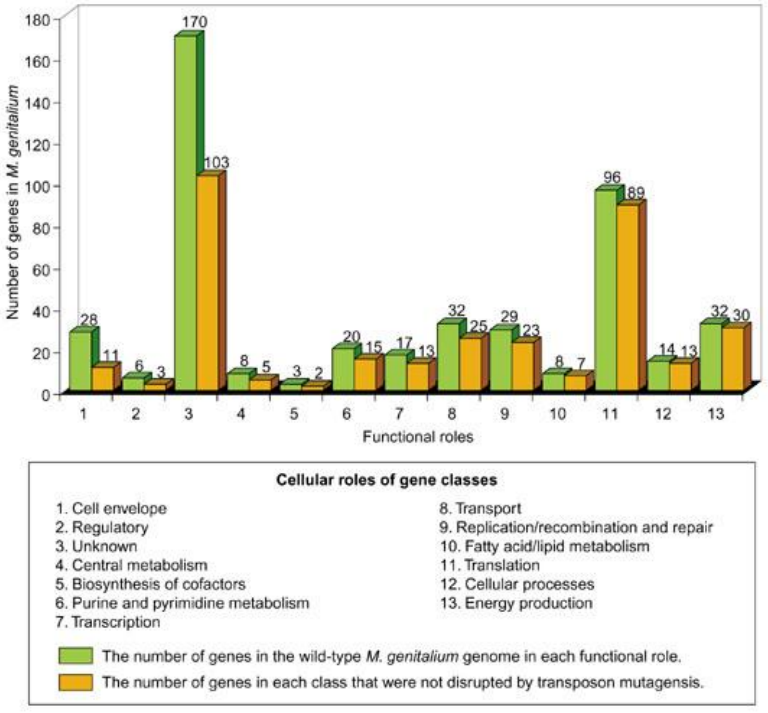
Synthetic Biology Group, J. Craig Venter Institute, 9704 Medical Center Drive, Rockville, MD 20850

Contributed by Hamilton O. Smith, November 18, 2005

PNAS (2006) 103, 425--430

Gene Function

Function	Number of Genes
Cell Envelope	28
Regulatory	6
Unknown	170
Central Metabolism	8
Cofactor Biosynthesis	3
Purine/Pyrimidine meta	20
Transciption	17
Transport	32
Replication/Repair	29
Lipid metabolism	8
Translation	96
Cellular Processes	14
Energy Production	32

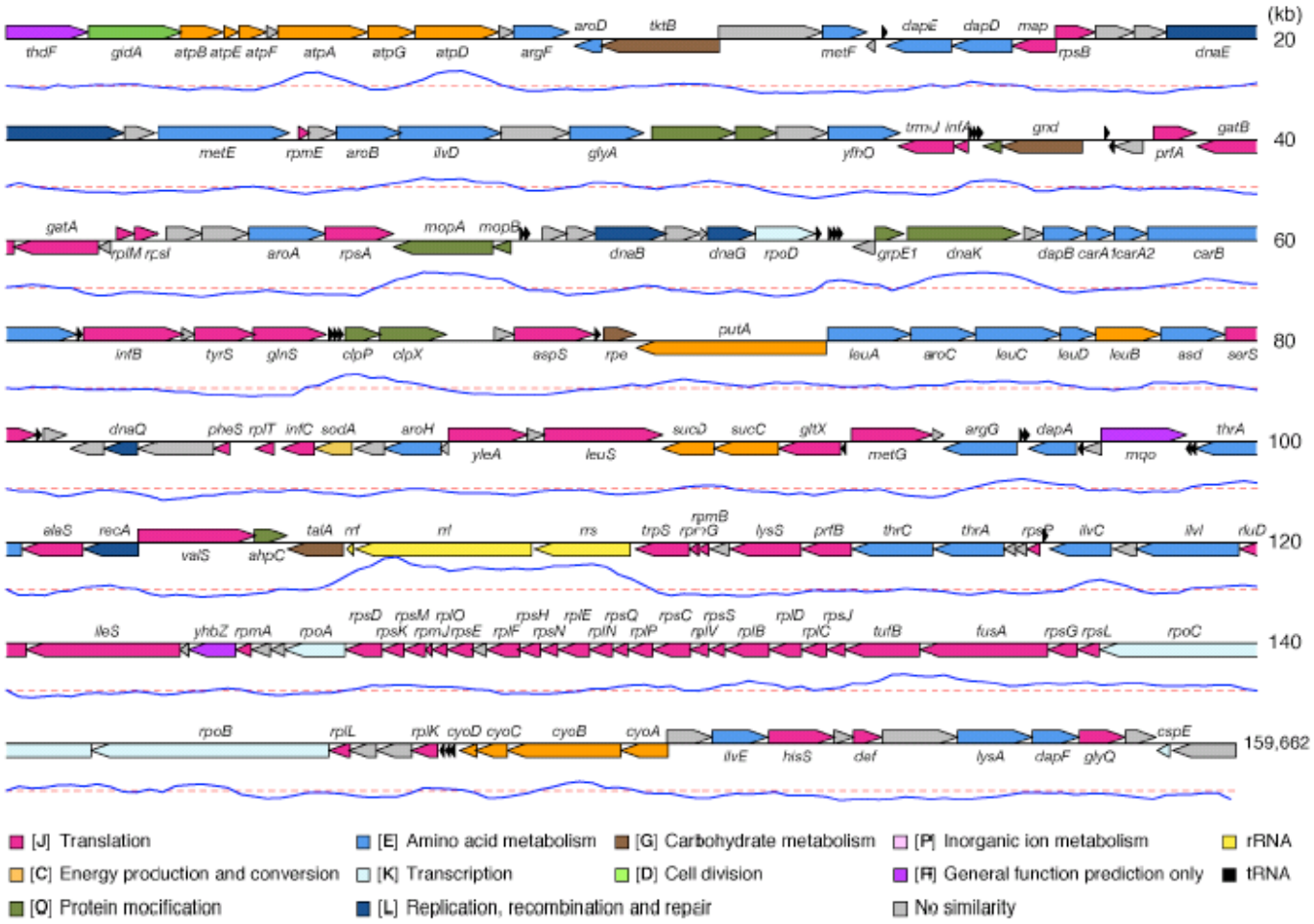


The complexity of simplicity

Scott N Peterson and **Claire M Fraser**

Genome Biol. 2001;2(2):COMMENT2002. Epub 2001 Feb 8.

But the real prize goes to….



The 160-Kilobase Genome of the Bacterial Endosymbiont *Carsonella*

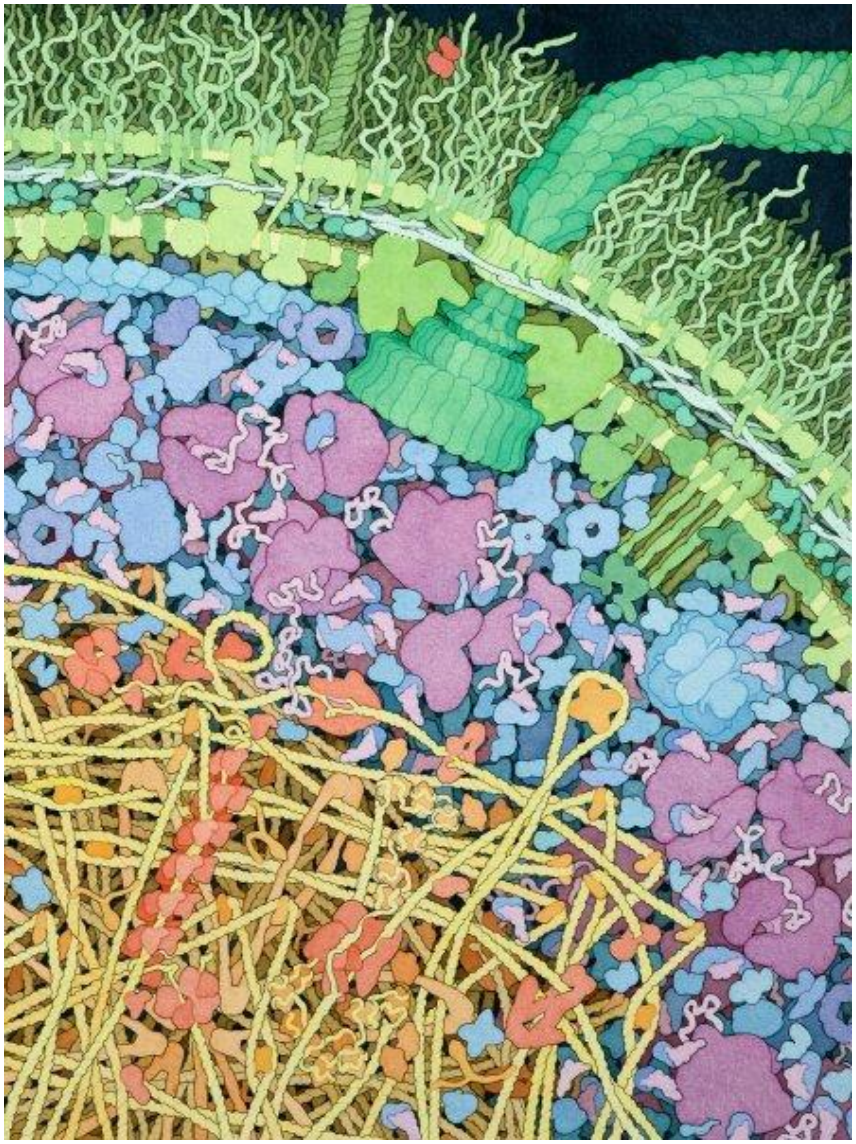
Atsushi Nakabachi, Atsushi Yamashita, Hidehiro Toh, Hajime Ishikawa, Helen E. Dunbar, Nancy A. Moran, and Masahira Hattori

(13 October 2006)

Science **314** (5797), 267.

160-Kilobase Genome of the Bacterial Endosymbiont *Carsonella*
***Symbiont of sap sucking* PSYLLIDS or 'jumping plant lice' ~182 genes**

E. Coli Statistics



Length: 2 to 3 um
Diameter: 1 um
Generation time: 20 to 30 mins

Translation rate: 40 aa/sec
Transcription rate: 70 nt/sec

Number of ribosomes per cell : 18,000

Small Molecules/Ions per cell:

Alanine:	350,000
Pyruvate:	370,000
ATP:	2,000,000
Ca ions:	2,300,000
Fe ions:	7,000,000

Data from: http://bionumbers.hms.harvard.edu
http://redpoll.pharmacy.ualberta.ca/CCDB/cgi-bin/STAT_NEW.cgi

David S. Goodsell (Scripps)

E. Coli Statistics

E coli has approximately 4300 protein coding genes.

Function	Number of Genes
Amino Acid Biosynthesis	131
Cofactors Biosynthesis	103
Nucleotide Biosynthesis	58
Cell Envelope	237
Energy metabolism	243
Intermediary metabolism	188
Lipid metabolism	48
DNA replication, repair	115
Protein Folding	9
Regulatorty proteins	178
Transcirption	55
Translation	182
Membrane transport	427

Source: Protein abundance profiling of the Escherichia coli cytosol. BMC Genomics 2008, 9:102. Ishihama et al.

Protein abundance per cell:

ATP Dependent helicase: 104

LacI repressor: 10 to 50 molecules
LacZ (galactosidase) : 5000

CheA kinase (chemotaxis): 4,500
CheB (Feedback): 240
CheY (Motor signal): 8,200
Chemoreceptors: 15,000

Glycolysis
Phosphofructokinase: 1,550
Pyruvate Kinase: 11,000
Enolase: 55,800
Phosphoglycerate kinase: 124,000

Krebs Cycle
Malate Dehydrogenase: 3,390
Citrate Synthase: 1,360
Aconitase: 1630