Table 1. Building blocks needed to produce 1 g of *E. coli* protoplasm

Building block	Amount present in *E. coli* B/r (μmol/g dried cells)	Cost of making 1 μmol of each of these building blocks (μmol/μmol)						
		Metabolites[a]	ATP	NADH	NADPH	1-C	NH_4^+	S
Protein amino acids								
Alanine	488	1 pyr	0	0	1	0	1	0
Arginine	281	1 αkg	7	−1	4	0	4	0
Asparagine	229	1 oaa	3	0	1	0	2	0
Aspartate	229	1 oaa	0	0	1	0	1	0
Cysteine	87	1 pga	4	−1	5	0	1	1
Glutamate	250	1 αkg	0	0	1	0	1	0
Glutamine	250	1 αkg	1	0	1	0	2	0
Glycine	582	1 pga	0	−1	1	−1	1	0
Histidine	90	1 penP	6	−3	1	1	3	0
Isoleucine	276	1 oaa, 1 pyr	2	0	5	0	1	0
Leucine	428	2 pyr, 1 acCoA	0	−1	2	0	1	0
Lysine	326	1 oaa, 1 pyr	2	0	4	0	2	0
Methionine	146	1 oaa	7	0	8	1	1	1
Phenylalanine	176	1 eryP, 2 pep	1	0	2	0	1	0
Proline	210	1 αkg	1	0	3	0	1	0
Serine	205	1 pga	0	−1	1	0	1	0
Threonine	241	1 oaa	2	0	3	0	1	0
Tryptophan	54	1 penP, 1 eryP, 1 pep	5	−2	3	0	2	0
Tyrosine	131	1 eryP, 2 pep	1	−1	2	0	1	0
Valine	402	2 pyr	0	0	2	0	1	0
RNA nucleotides								
ATP	165	1 penP, 1 pga	11	−3	1	1	5	0
GTP	203	1 penP, 1 pga	13	−3	0	1	5	0
CTP	126	1 penP, 1 oaa	9	0	1	0	3	0
UTP	136	1 penP, 1 oaa	7	0	1	0	2	0
DNA nucleotides								
dATP	24.7	1 penP, 1 pga	11	−3	2	1	5	0
dGTP	25.4	1 penP, 1 pga	13	−3	1	1	5	0
dCTP	25.4	1 penP, 1 oaa	9	0	2	0	3	0
dTTP	24.7	1 penP, 1 oaa	10.5	0	3	1	2	0
Lipid components								
Glycerol phosphate	129	1 triosP	0	0	1	0	0	0
Serine	129	1 pga	0	−1	1	0	1	0
$C_{16:0}$ fatty acid (43%)		8 acCoA	7	0	14	0	0	0
$C_{16:1}$ fatty acid (33%)		8 acCoA	7	0	13	0	0	0
$C_{18:1}$ fatty acid (24%)		9 acCoA	8	0	15	0	0	0
Average fatty acid	258	8.2 acCoA	7.2	0	14	0	0	0

[a]acCoA, Acetyl CoA; eryP, erythrose 4-phosphate; fruP, fructose 6-phosphate; gluP, glucose 6-phosphate; αkg, α-ketoglutarate; oaa, oxaloacetate; penP, ribose 5-phosphate; pep, phosphoenolpyruvate; pga, 3-phosphoglycerate; pyr, pyruvate; triosP, triose phosphate.

(*Table 1 continues*)

Table 1. (Continued)

Building block	Amount present in *E. coli* B/r (μmol/g dried cells)	Cost of making 1 μmol of each of these building blocks (μmol/μmol)						
		Metabolites[a]	ATP	NADH	NADPH	1-C	NH_4^+	S
LPS components								
UDP-glucose	15.7	1 gluP	1	0	0	0	0	0
(CDP) ethanolamine	23.5	1 pga	3	−1	1	0	1	0
OH-myristic acid	23.5	7 acCoA	6	0	11	0	0	0
$C_{14:0}$ fatty acid	23.5	7 acCoA	6	0	12	0	0	0
(CMP) KDO	23.5	1 penP, 1 pep	2	0	0	0	0	0
(NDP) heptose	23.5	1.5 gluP	1	0	−4	0	0	0
(TDP) glucosamine	15.7	1 fruP	2	0	0	0	1	0
Peptidoglycan monomers								
UDP-*N*-acetylglucosamine	27.6	1 fruP, 1 acCoA	3	0	0	0	1	0
UDP-*N*-acetylmuramic acid	27.6	1 fruP, 1 pep, 1 acCoA	4	0	1	0	1	0
Alanine	55.2	1 pyr	0	0	1	0	1	0
Diaminopimelate	27.6	1 oaa, 1 pyr	2	0	3	0	2	0
Glutamate	27.6	1 αkg	0	0	1	0	1	0
Glycogen monomers								
Glucose	154	1 gluP	1	0	0	0	0	0
1-Carbon requirement								
Serine	48.5	1 pga	0	−1	1	0	0	0
Polyamines								
Ornithine equivalents	59.3	1 αkg	2	0	3	0	2	0

Other (small) molecules (less than 3% of cell dry weight)

Coenzymes: NAD, NADP, CoA, CoQ, bactoprenoid, tetrahydrofolate, cyanocobalamin, pyridoxal phosphate

Prosthetic groups: FMN, FAD, biotin, cytochromes, lipoic acid, thiamine pyrophosphate

Pool of unpolymerized monomers: average approximately 1% of amount in macromolecules

Table 2. Requirements for biosynthesis of building blocks

Precursor metabolite	Amount required[a] (μmol/g cells)	Precursor metabolite	Amount required[a] (μmol/g cells)
Glucose 6-phosphate	205	Succinyl CoA	—[b]
Fructose 6-phosphate	70.9	Oxaloacetate	1,786.7
Ribose 5-phosphate	897.7	~P	18,485
Erythrose 4-phosphate	361	$NADH_2$	(−3,547)
Triose phosphate	129	$NADPH_2$	18,225
3-Phosphoglycerate	1,496	1-C (accounted for as serine)	—[c]
Phosphoenolpyruvate	519.1	NH_4^+	10,180
Pyruvate	2,832.8	S	233
Acetyl CoA	3,747.8		
α-Ketoglutarate	1,078.9		

[a]Calculated from the information in Table 1 by multiplying the amount of each building block (first column of figures) by the molar requirement of precursor metabolites or other components to produce them.
[b]Succinyl CoA is used as a cofactor in the synthesis of building blocks, that is, succinate is later released from the biosynthetic intermediates. Therefore, there is a net expenditure of 1 ~P in the synthesis of lysine and methionine. Succinyl CoA is a precursor metabolite, however, in the synthesis of heme and hemelike compounds.
[c]The requirement for 1-C fragments in the synthesis of methionine, purines, and thymine has been arbitrarily accounted for by synthesizing the requisite number of serine molecules.