**Supplementary material for table on macromolecular cell composition.**

Protein - taken from F. C. Neidhardt et al., “Physiology of the bacterial cell”, Sinauer, 1990, and adapted by rounding values .

**RNA content** – taken from F. C. Neidhardt et al., “Physiology of the bacterial cell”, Sinauer, 1990, and adapted by rounding values.

rRNA – molecular weight

* 23S rRNA: 941813.06 Da (from [sequence](http://ecoliwiki.net/colipedia/index.php/23S_rRNA)) ≈ **1 ·106 Da**
* 16S rRNA: 499837.62 Da (from [sequence](http://ecoliwiki.net/colipedia/index.php/16S_rRNA)) ≈ **5 ·105 Da**
* 5S rRNA: 38994.32 Da (from [sequence](http://ecoliwiki.net/colipedia/index.php/5S_rRNA)) ≈ **4 ·104 Da**
* tRNA:
86 different types (PMID: 18984615)
average 77 (73-92) bases (average not weighted by abundance)
≈ **2.3 ·104 Da**

DNA – molecular weight

* 4578159 bp (from genome sequence)
* with one dNMP weighing ≈ 330 Da
calculated as the mean of the molecular weights of the 4 DNA nucleotides (Base + Ribose + 1 Phosphate)
dAMP (CHEBI:17713)    330 Da
dGMP (CHEBI:16192)    347 Da
dTMP  (CHEBI:17013)    322 Da
dCMP  (CHEBI:15918)    307 Da
* and 2 strands

 **3.0 × 109 Da.**

 At 40 min doubling time there are about 2 copies of the double stranded DNA (according to the C/D model the exact value is 2 1/8 copies which we choose to round).

Lipopolysaccaride –

For molecular weight we used a monomer composed of:
O-Antigen Serotypes O1 – O181, on average 14 (9-19) repeats of 4 C6-sugars (PMID: 24733938)
 ≈ **5600 Da**
Core Antigen 5 different types (of which one is K-12)
 “While all of the outer core OSs share a structural theme, with a (hexose)3
 carbohydrate backbone and two side chain residues, the order of hexoses in the
 backbone and the nature, position, and linkage of the side chain residues can all
 vary” (PMID: 10678915)
 ≈ 5 Hexoses: **900 Da**
Lipid A 6 C14-fatty acids, with 2 phosphorylated C6-sugars (≈ **1600 Da**, measured 1798 Da
 (Endotoxin in Health and Disease, edited by Helmut Brade, 1999, p18))

In total: ≈ **8000 Da**

Peptidoglycan – molecular weight

* Overall a molecular mass of more than 3 × 109 Da (PMID: 15342566)
* Subunits: 2 Sugars (*N*-acetylglucosamine and *N*-acetylmuramic acid) and a pentapeptide (Ala-Glu-*m*Dap-Ala-Ala)  ≈ 220 Da + 290 Da + 5\*100 Da ≈ **1000 Da**

The cell wall peptidoglycan layer (sacculus) is thought to be connected and thus considered as one molecule composed of n peptidoglycan monomers of about 1000 Da each.
Assuming (as in the table) that the whole cell wall peptidoglycan weighs 9 fg ≈ 5×109 Da, we get **n** ≈ **5×106.** (A useful summary on the cell wall peptidoglycan layer can be found in PMID20060721, Fig. 1A.)
PMID:15342566 states that “The sacculus of *Escherichia coli* is one giant macromolecule with a molecular mass of more than **3 × 109 Da**” which would translate to a **5 fg** lower bound.

Glycogen – molecular weight

“In bacteria, the average length of the chains is 8–12 glucose units, and the molecular size of glycogen has been estimated to be about 107–108 Da.” (PMID 20412306, but no primary source)

Derivation of number of carbons per cell -

For a cell dry mass of 0.3 pg and carbon content of 48% (BNID 101 800). There are 0.3**× 10-12**g × 0.48 × 6**× 1023** / 12 ≈ **7.5×109**  carbon atoms per cell. We round this to 1010.

Number of ATP -

According to BNID 111461, the growth associated maintenance costs are 0.46 mol ATP/ mol biomass C.

This translates to 0.46 x 7.5**×109**  ≈ 3.5**×109**  ATP.

There is also 0.075 mol of ATP/C- mol of biomass/h. for the 2/3 of the hour discussed here we get another 0.4**×109**  ATP.

This does not include ATP that is accounted in the detailed stoichiometry of cell construction that includes most importantly protein polymerization but also lipid biosynthesis, precursor building blocks synthesis, transport processes etc. Those were accounted for separately and as shown for example by A. H. Stouthamer 1973 (BNID 104848, assuming it refers to cell dry weight), and amount to another ≈ 7**×109**  ATP per 1 μm3 cell volume.

Number of glucose molecules needed -

Carbon yield for E. coli growing in minimal media on glucose is about 0.5 in terms of mass (but also in terms of carbon I think it is very close). This means that from the number of carbons there should be about 15**×109** carbons in the sugar consumed. This corresponds to 2.5**×109**  glucose molecules. Because this is experimental it should include all losses and does not have the limitations of a theoretical estimate.