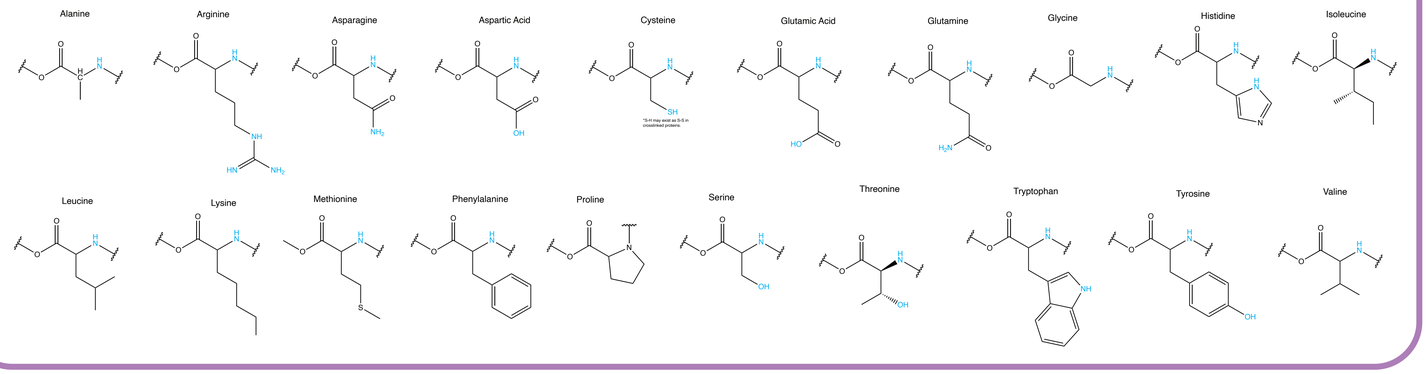
What are the sources of exchangeable hydrogen in common biomolecules?

Using the molecular inventory estimates published in Chemical Composition of Eschericia Coli (Neidhardt 1987), we can estimate the fraction of a cell's hydrogen that exists in readily exchangeable sites. These sites include amine, hydroxyl, carboxyl, sulfide, imine, etc. These groups spontaneously exchange with water in a matter of picoseconds to minutes.

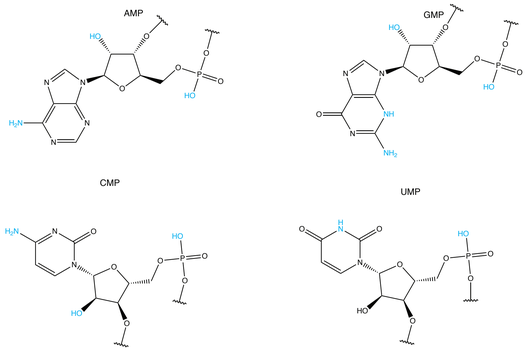
We note that these estimates are rough, and that microorganisms vary in their molecular compositions.

Protein

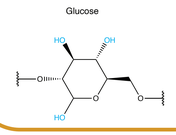
Protein comprises 55% of total cell dry weight, with an average molecular weight of $4x10^4$.
The amide and side-chain hydrogens exchange in a matter of picoseconds to minutes, depending on how shielded the site is.



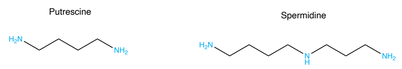
RNA



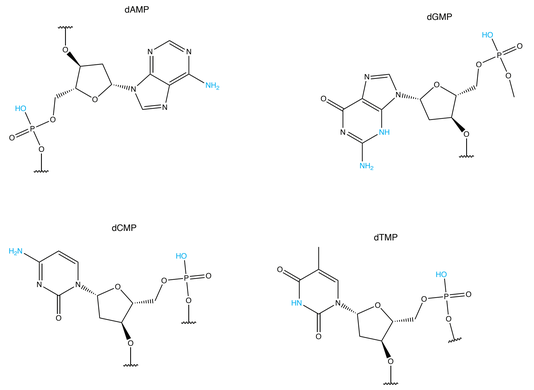
Glycogen



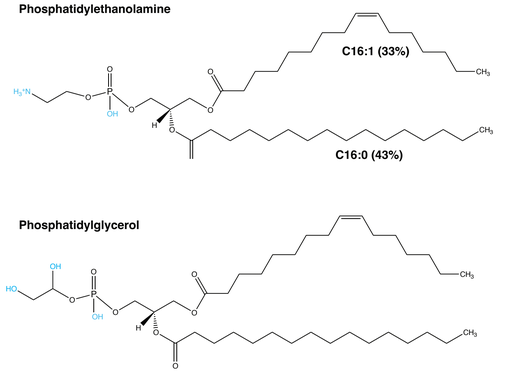
Polyamines



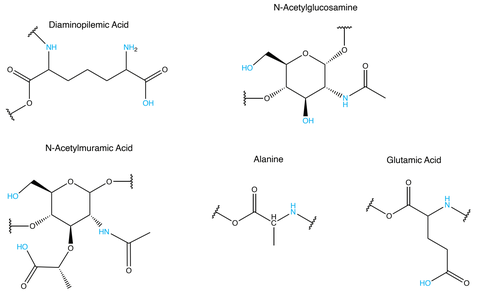
DNA



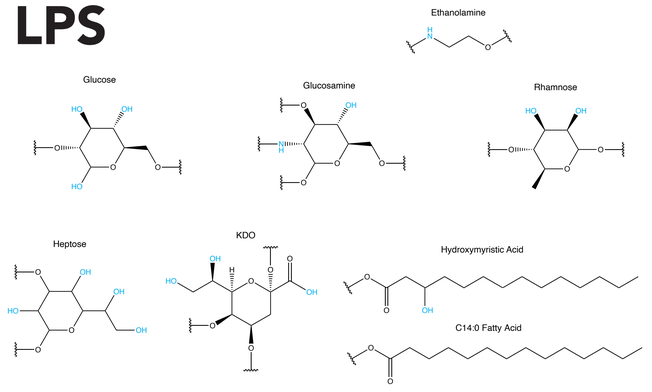
Lipids

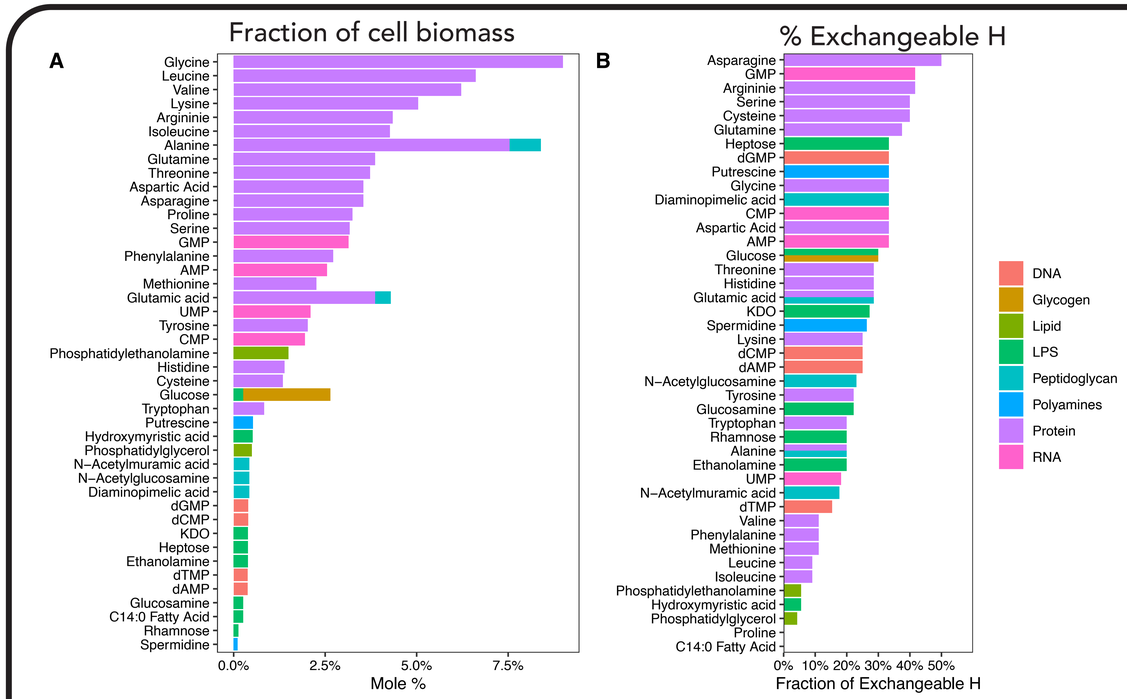


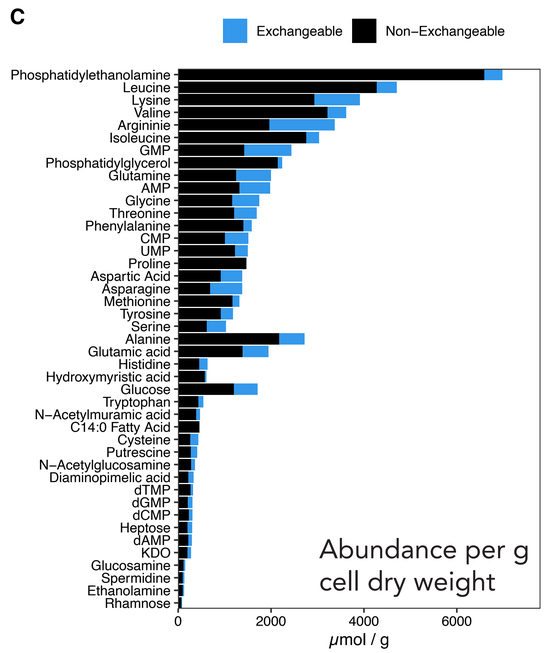
Peptidoglycan



LPS







Of a single cell...

~21%

of its biomass hydrogen is exchangeable with water.