

Protein Structure and Function

Most of this material is in chapter 4; basics are in chapter 2.

Introduction

organization of molecules in cells:

atoms, small molecules, macromolecules, supermolecular aggregates.

Atoms

95% of cell's dry weight is C, O, H, N, P, S.

Na, K, Cl, Ca, Fe, Zn are each present at less than 1%.

Small molecules

Cells are 70% water, nearly 30% carbon compounds.

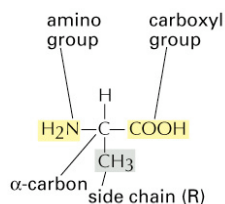
Molecules are covalently bonded atoms

Covalent bonds

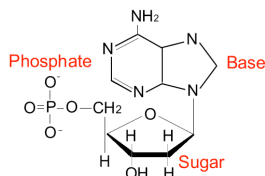
A handful of functional groups are common in molecules of living cells

Four main classes of small molecules (MW = 100-1000):

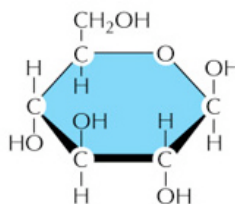
amino acids



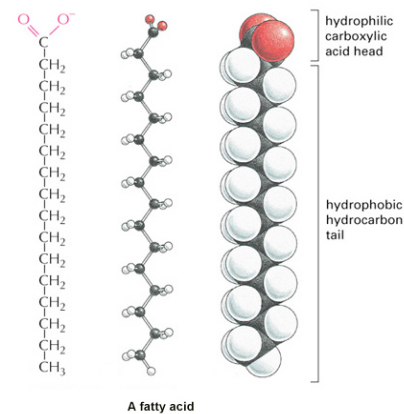
nucleotides



sugars



lipids

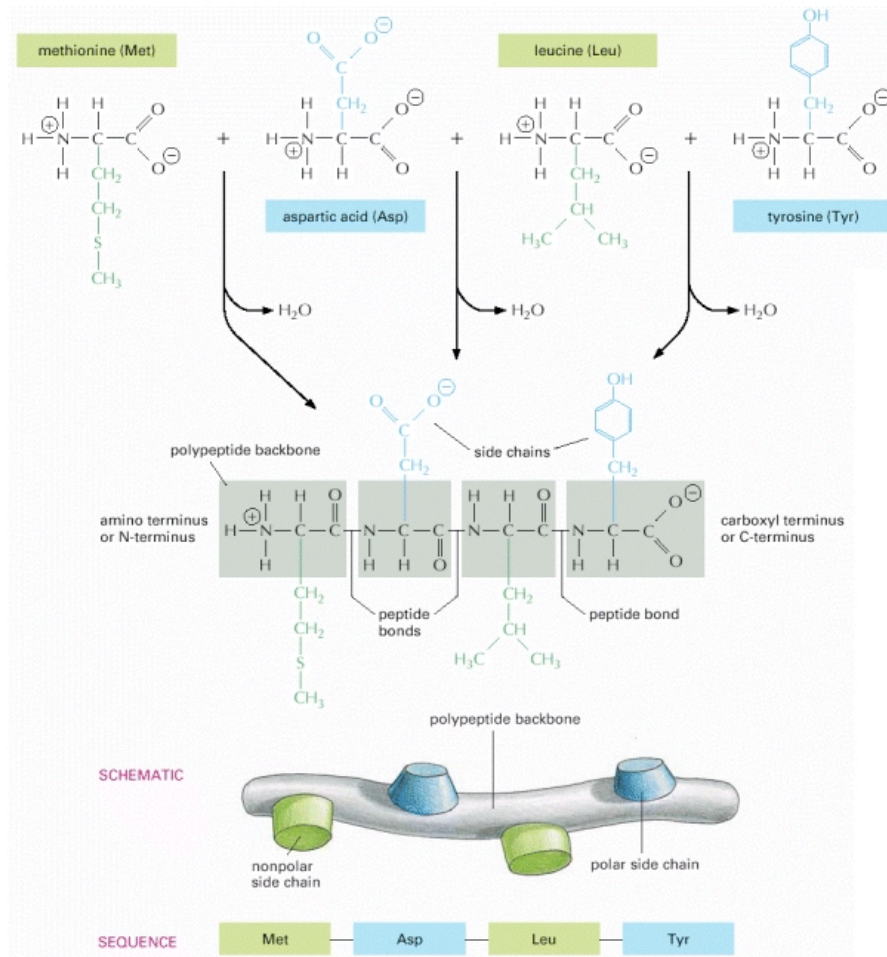


Macromolecules (MW = 1000-1,000,000, consist of subunits linked by covalent bonds)

Nucleic acids

Polysaccharides

Proteins



Weak bonds (panel 2-7)

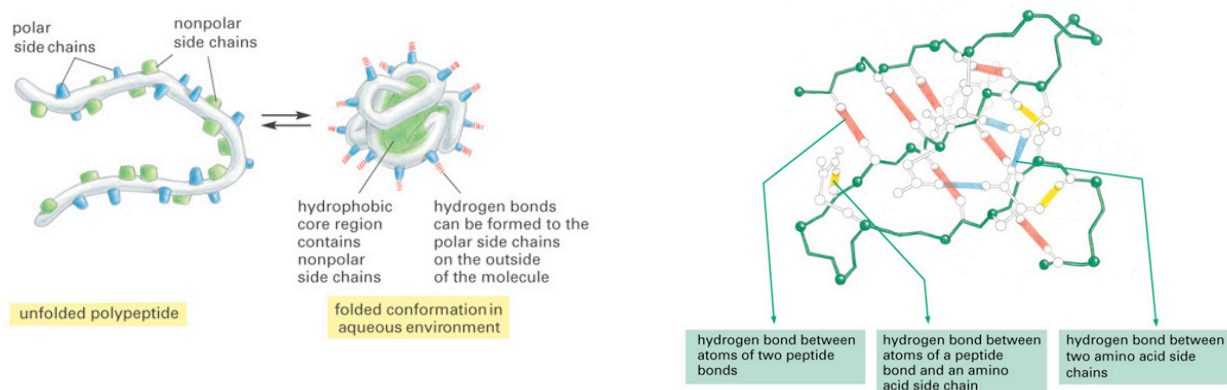
1. Hydrogen bonds
2. Hydrophobic interactions
3. Ionic bonds
4. van der Waals interactions

The role of weak bonds

The 20 amino acid subunits are grouped by important characteristics.

AMINO ACID	SIDE CHAIN	AMINO ACID	SIDE CHAIN
Aspartic acid	Asp D negative	Alanine	Ala A nonpolar
Glutamic acid	Glu E negative	Glycine	Gly G nonpolar
Arginine	Arg R positive	Valine	Val V nonpolar
Lysine	Lys K positive	Leucine	Leu L nonpolar
Histidine	His H positive	Isoleucine	Ile I nonpolar
Asparagine	Asn N uncharged polar	Proline	Pro P nonpolar
Glutamine	Gln Q uncharged polar	Phenylalanine	Phe F nonpolar
Serine	Ser S uncharged polar	Methionine	Met M nonpolar
Threonine	Thr T uncharged polar	Tryptophan	Trp W nonpolar
Tyrosine	Tyr Y uncharged polar	Cysteine	Cys C nonpolar

Protein conformation



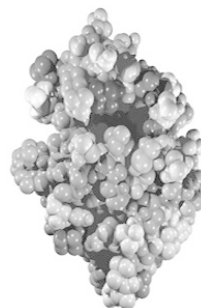
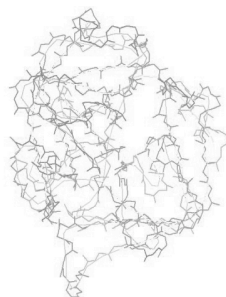
Four ways of representing protein conformation:

backbone model

ribbon model

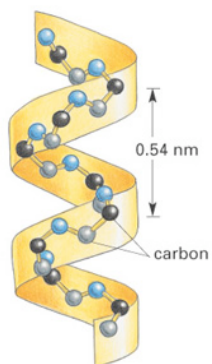
wire model

space-filling model

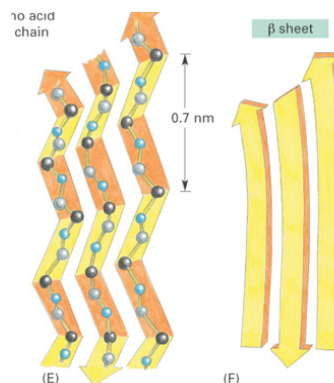


Common folding patterns:

α -helix



β -sheet



Proteins have four levels of structural organization:
primary (sequence), secondary, tertiary, quaternary

X-ray crystallography and NMR spectroscopy- methods for determining protein structure

Protein Function

Proteins function as enzymes, structural proteins, transport proteins, motor proteins, storage proteins, signaling proteins, receptor proteins, gene regulatory proteins.

Protein binding to other molecules

ligands

binding sites

Antibodies

How enzymes work

Conformational changes in proteins

Motor proteins