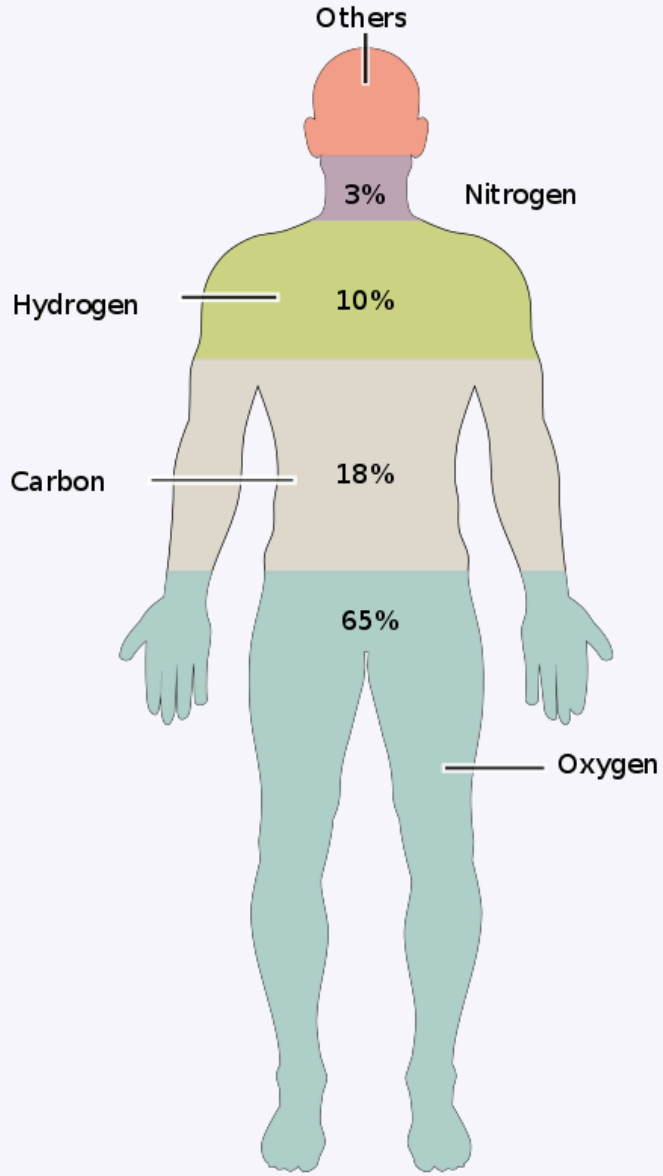
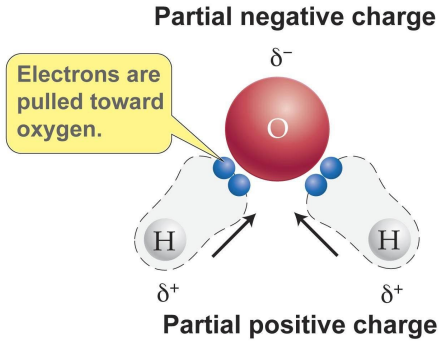
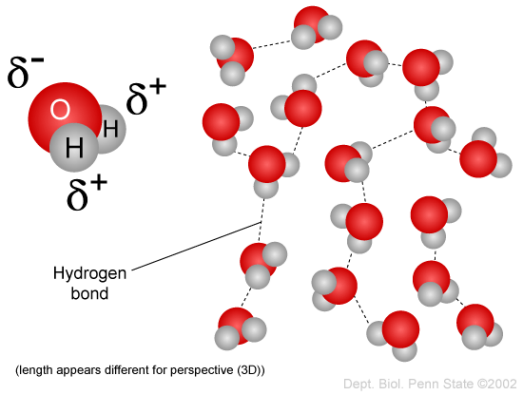


Element	Symbol	% in body
Oxygen	O	65.0
Carbon	C	18.5
Hydrogen	H	9.5
Nitrogen	N	3.2
Calcium	Ca	1.5
Phosphorus	P	1.0
Potassium	K	0.4
Sulfur	S	0.3
Sodium	Na	0.2
Chlorine	Cl	0.2
Magnesium	Mg	0.2
Others		< 1.0

The main elements that compose the human body are shown from most abundant (by mass, not by fraction of atoms) to least abundant.

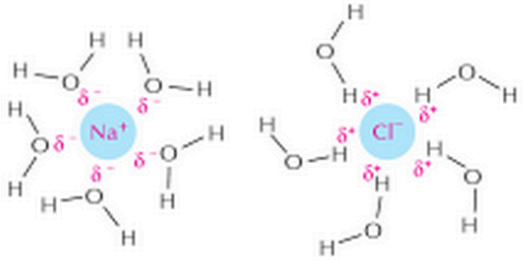
Polar – hydrophilic – water soluble



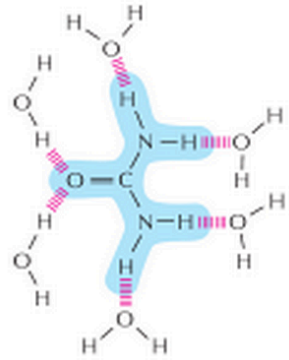


HYDROPHILIC MOLECULES

Substances that dissolve readily in water are termed **hydrophilic**. They include ions and polar molecules that attract water molecules through electrical charge effects. Water molecules surround each ion or polar molecule and carry it into solution.

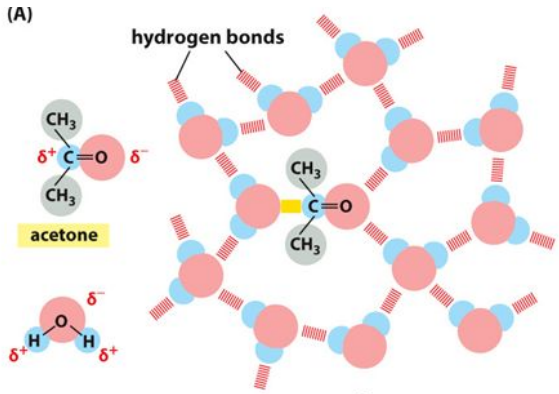


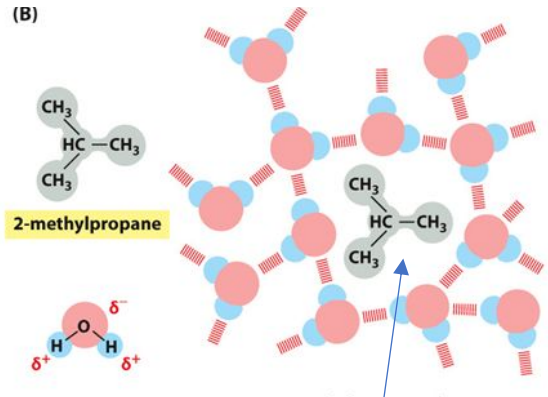
Ionic substances such as sodium chloride dissolve because water molecules are attracted to the positive (Na^+) or negative (Cl^-) charge of each ion.



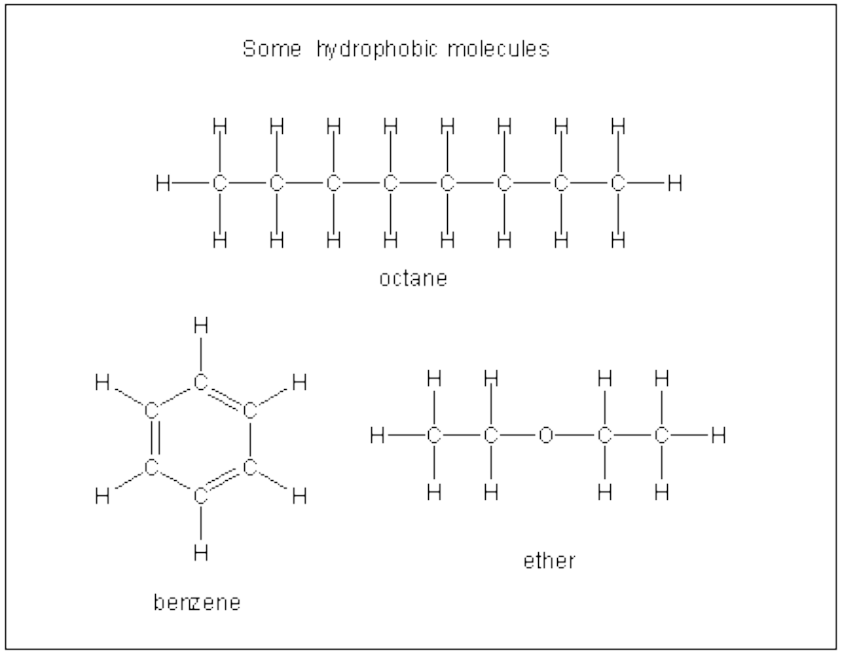
Polar substances such as urea dissolve because their molecules form hydrogen bonds with the surrounding water molecules.

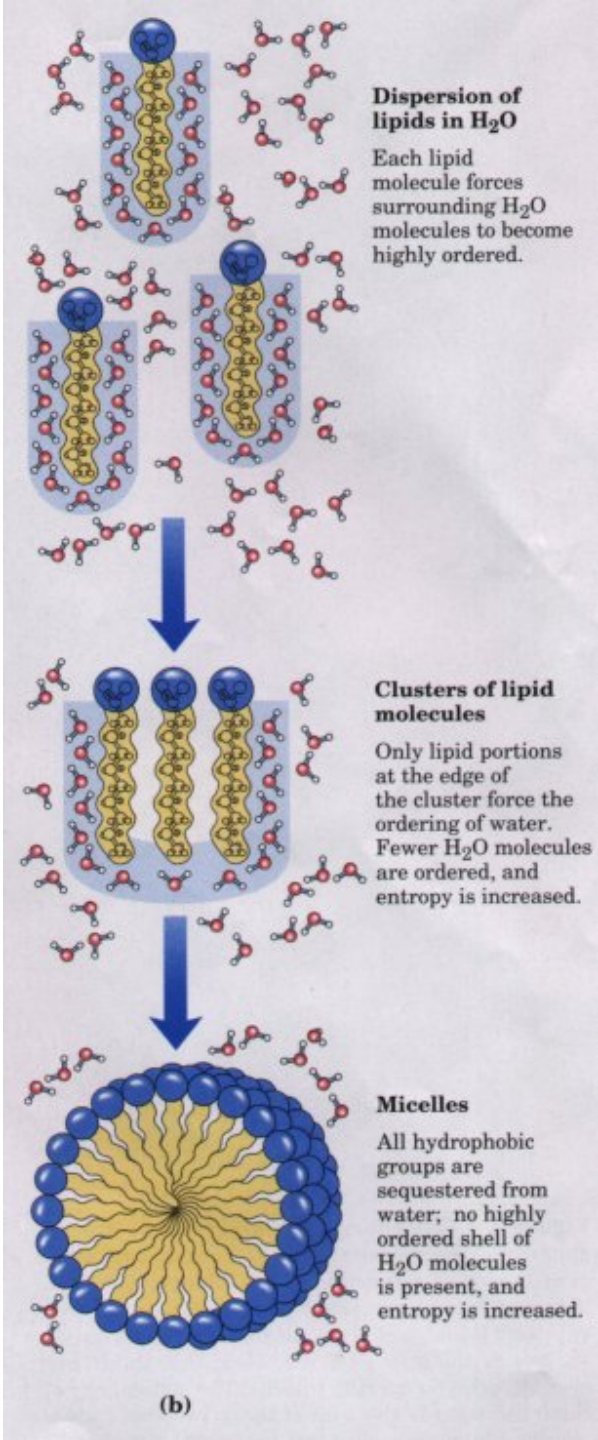
Hydrophobe & amphiphile





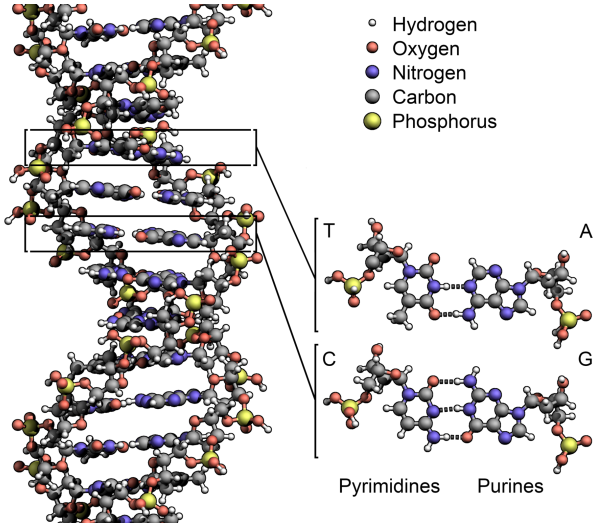
higher energy cost

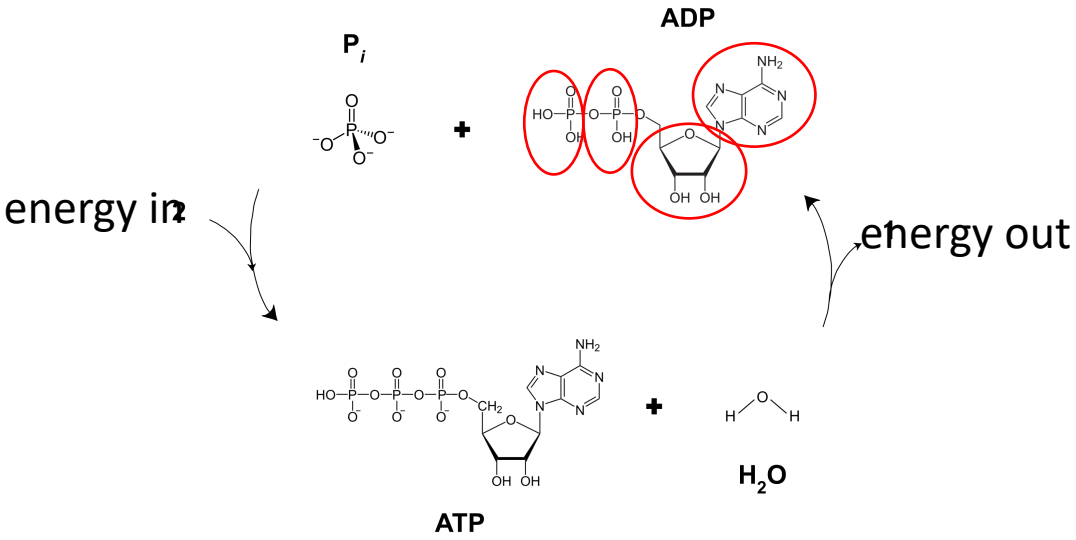


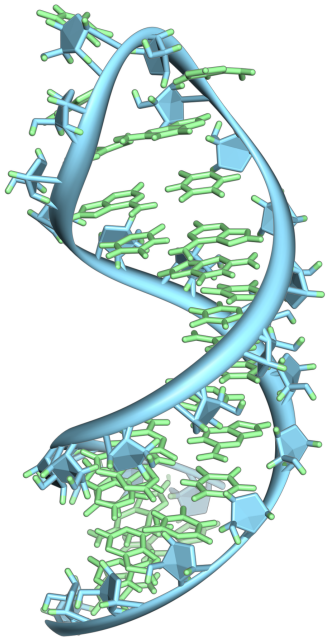


Important molecules

- Important nitrogenous bases: Adenine, Thymine, Guanine, Cytesine, Uracil
- Nucleic acids
  - DNA (DeoxyriboNucleic Acid): base pairs T-A, C-G
  - RNA (RiboNucleic Acid): single strands of G,U,A,C
- Nucleotide = (nitrogenous) base + sugar + phosphate
  - Adenine (base) + ribose (sugar) = Adenosine
  - ATP (Adenosine TriPhosphate)
  - ADP (Adenosine DiPhosphate)

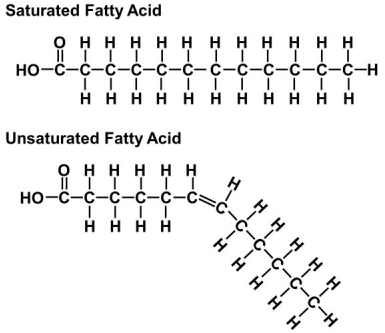


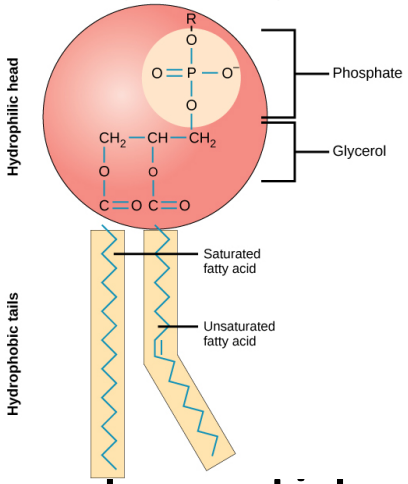


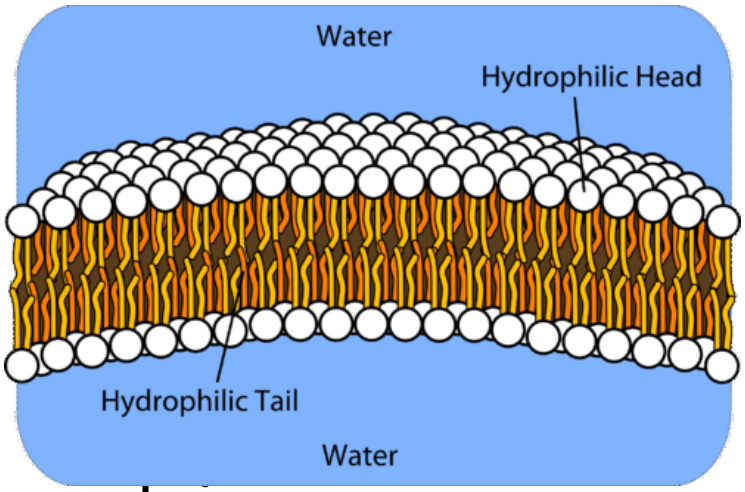


Important molecules

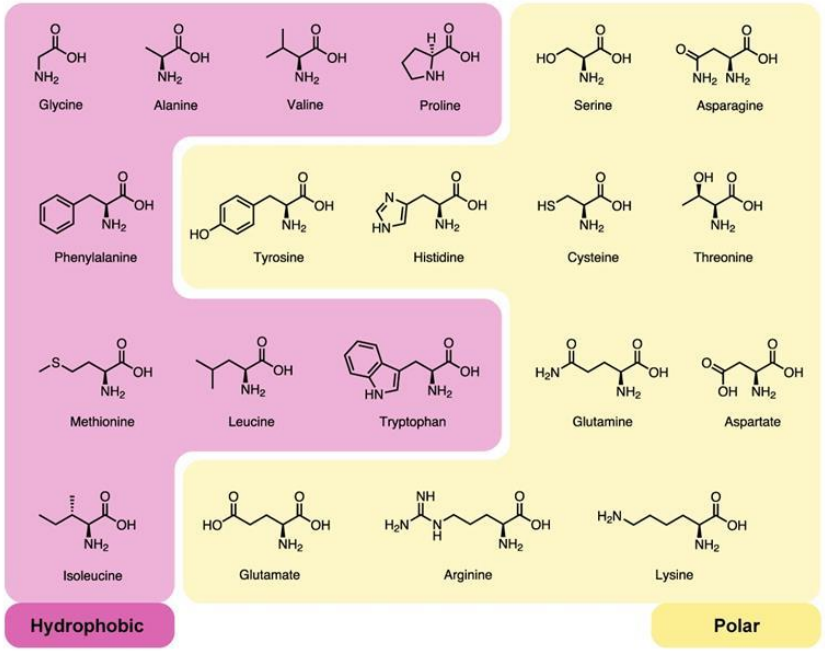
- fatty acids -> phospholipid -> membranes



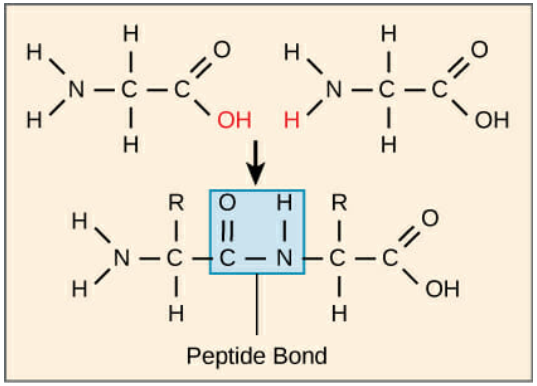




- amino acids -> polypeptides - proteins



Amino: NH2, Acid: OOH



Peptides: 2-50 amino acids

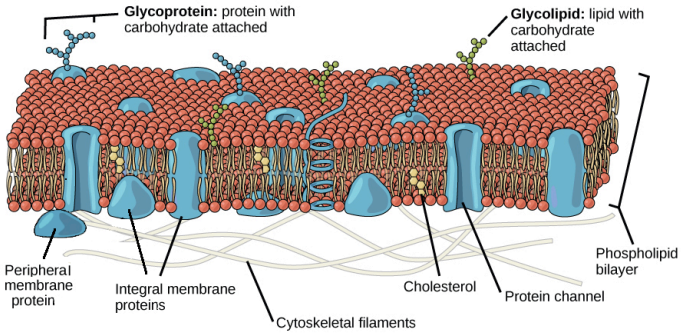
Proteins: >50 amino acids

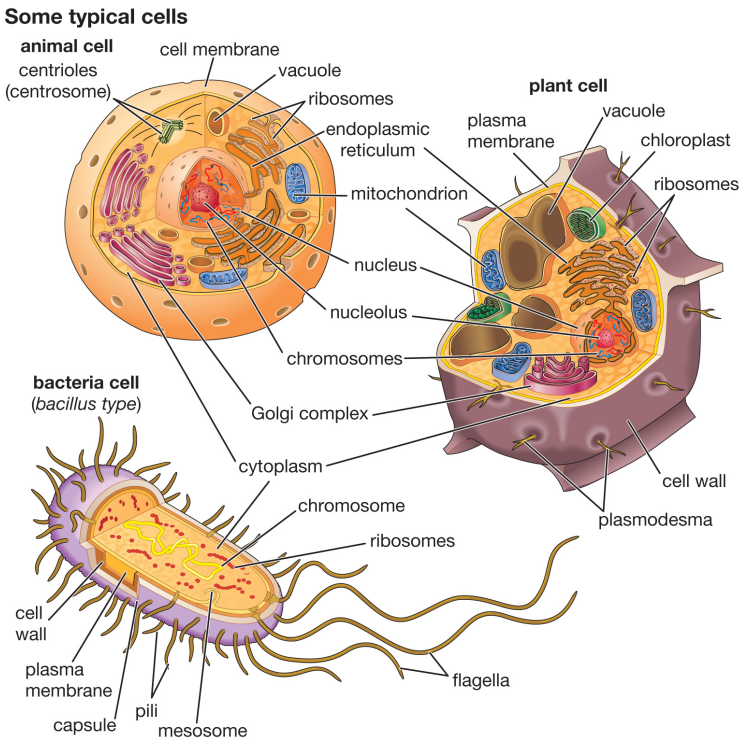
Molecule databases

- https://www.rcsb.org protein data bank
  - 1aoi
  - 1tau
  - 1mbn
- Proteins are folded
- info on different scales
- https://www.ucalgary.ca/tieleman/
- atomify

Cells – fundamental functional units of life

- enclosed by plasma membrane
- interior «soup» called cytoplasm
- organized in organelles = specialized compartments surrounded by membrane
  - nucleus: contains the genetic information necessary for cell growth and reproduction
  - mitochondria: responsible for the energy transactions necessary for cell survival
  - lysosomes: digest unwanted materials within the cell
  - endoplasmic reticulum & Golgi apparatus: organization of the cell by synthesizing selected molecules and then processing, sorting, and directing them to their proper locations





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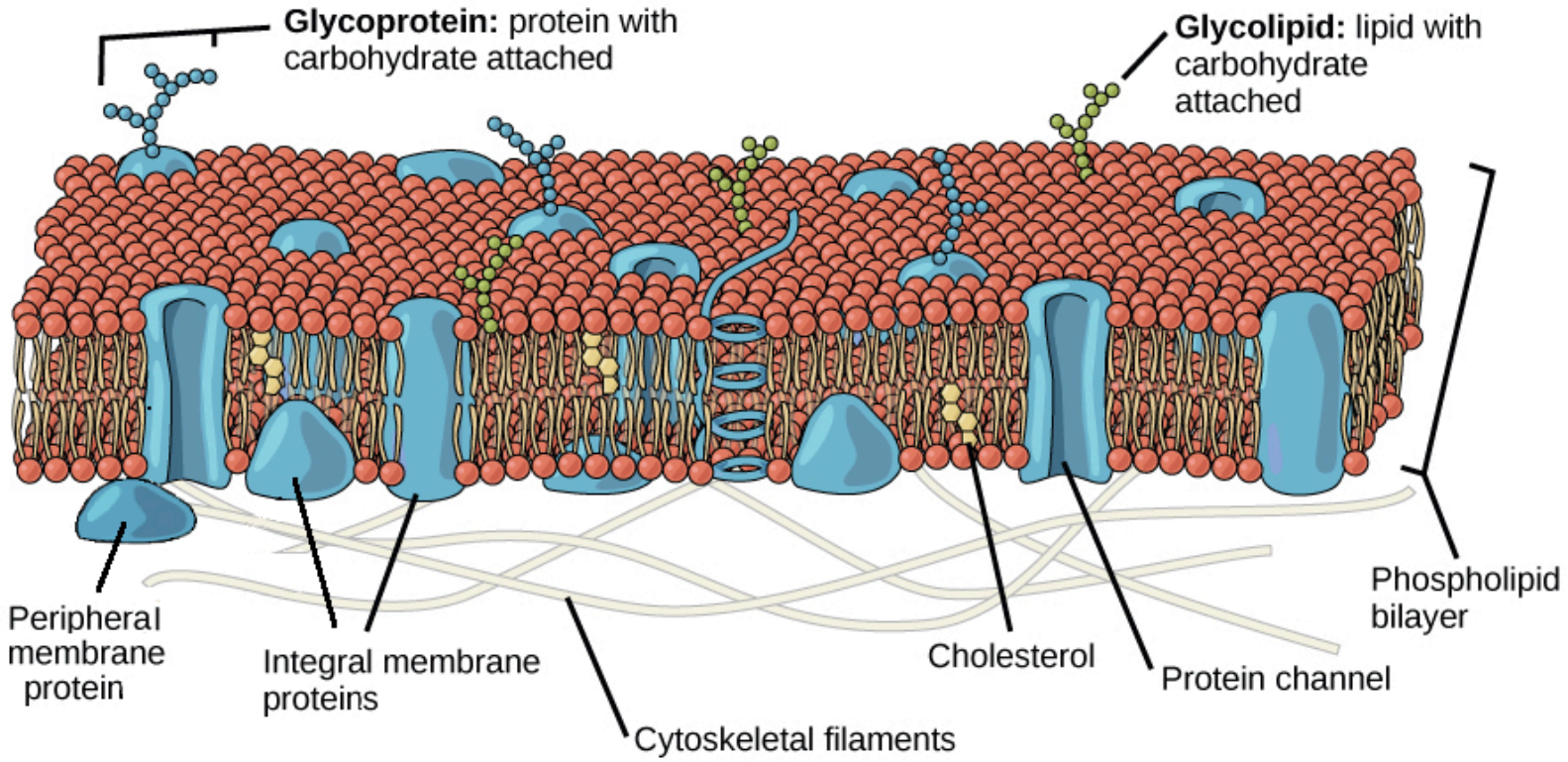
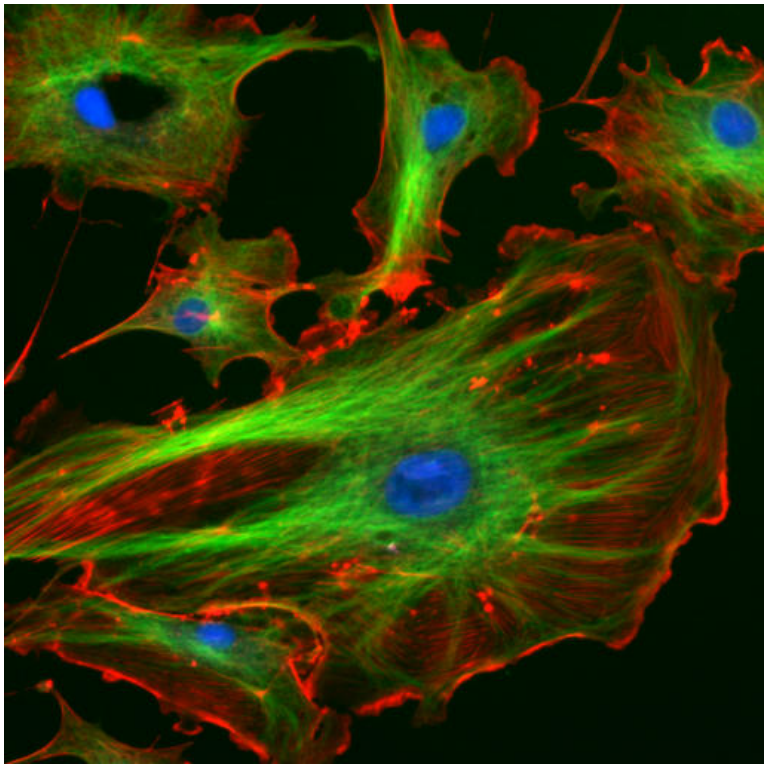
Plasma membrane



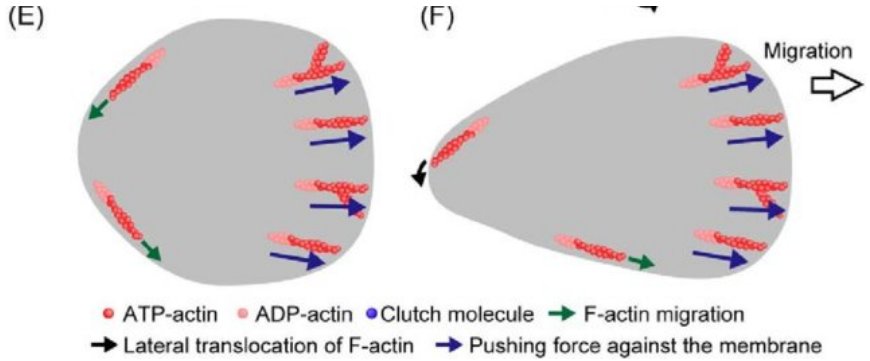
Cytosceleton

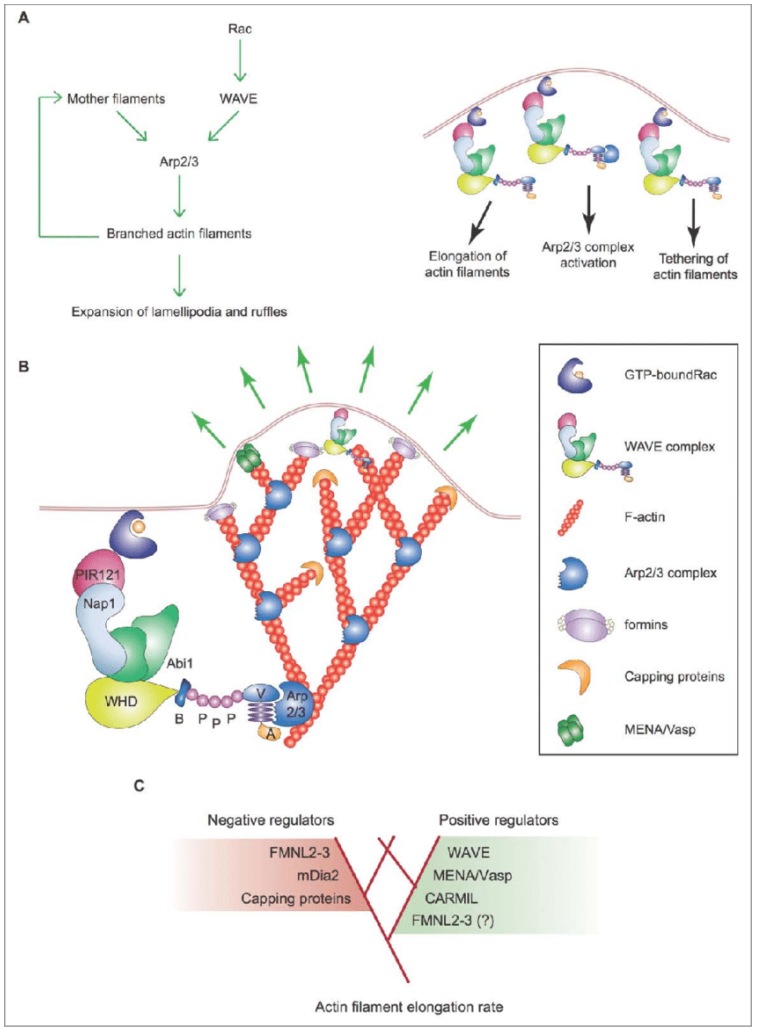
- actin filaments (7 nm Ø)
- microtubules (25 nm Ø)
- intermediate filaments (10 Ø)



The eukaryotic cytoskeleton. Actin filaments are shown in red, and microtubules composed of beta tubulin are in green.

G-actin monomer
F-actin polymer





Crash course in greek and latin:

Angio-	Vessel
-atomy, -otomy	cutting
Auto-	self
Brachy	short
Cata- (katalysis)	dissolving
Carcino-	tumor (crab-like)
Centro-, -centric	centre
-ceptor, ceptive	capere, to take
Chromo-	color
Chrono-	time
-cyte, cyto-	hollow
Diplo	double
e-, ec-	out of
Endo-	within, inside
Exo-	outside
Extra-	beyond
Erythro-	red
-gen, genous	descent
-genic, -genous	birth, descent, origin
-genic, -genous	to produce

Angiogenesis =production of vessels

Carcinogenesis = Production (development)of cancer

Crash course in greek and latin:

Glia-	glue
Haem-	blood
Histo-	tissue
Homeo-	alike
Homo-	the same
Hyper-	above
Hypo-	under
Infero-	beneath
Infra-	below
Inter-	between
Intra-	within
Iso-	equal
-kinesis, -kinetic	kinesis=movement
Leuko-	white
Lipo-	fat
-lysis, -lysin	dissolving
Macro-	large
Medi-	middle

Crash course in greek and latin:

-mere, mero-	a part
Meta-	after
Metabolism	change
Micro-	small
Mito- (mitosis)	a tread
Mono-	single
Muta-	mutare=to change
Necro-	dead
Neuro-	nerve
-nomics	law
Oligo-	few
Onco-	bulk, mass
Ortho-	straight
Para-	beside
Per-	through
Peri-	around
-phage, -phagous	phagein=to eat
-phil	to love

Centromere=
middle part

telomere=
end part

Crash course in greek and latin:

-phobe	to fear
Photo-	light
Plasma-, -plasm	form
-plicate	to fold
Post-	after
Pre-	before
Pro-	before
Proto-	first
Re-	back
Retro-	backwards
Serum	whey (myse)
-some, soma-	body
Stereo-, -steric	solid
Sub-	under
Super-	over
Supra-	above
Sym-, syn-	with

Crash course in greek and latin:

-synthesis	composition
Tauto-	the same
Tele-	far
Teleo-	complete
Telo-, telio-	end
Trans-	across
Ultra-	beyond

Statistical mechanics

- Model: MD (Atomify)
- micro x_i, m_i, v_i, f_{ij}, 10^{23}-> macro ρ, <v>, <v^2>, E_k,
- thermodynamics: P, T, c_P,H_v,... (stat + conservation laws)
- distributions: uniform, Gaussian, Poisson

$$P(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-x_0)^2}{2\sigma^2}}$$

- x->vx, x0->0, s
- <v>, <v^2>
- Model: ideal gas