Molekulska zgradba organizmov

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Organizmi so zgrajeni iz snovi

- Snovi so zgrajene iz kemijskih elementov
- 25 elementov je bistvenega pomena za življenje → BIOGENI ELEMENTI
- Vsi organizmi imajo podobno kemijsko zgradbo:

- C, H, O, N → 96% mase človeka

- Večino H in O predstavlja voda

- Večina C je vezanega v organskih snoveh

- Ca, P, K, S, Na, Cl, Mg → 4%

- 14 elementov v sledovih (B, Cr, Cu, F, I, Fe, Zn,…) → manj kot 0,01% → mikroelementi

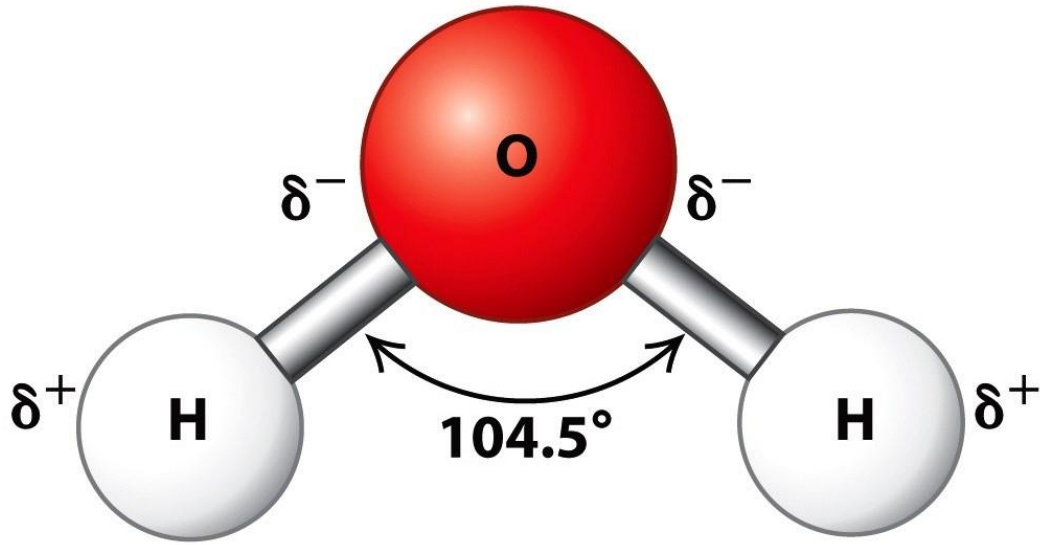
- Esencialni elementi

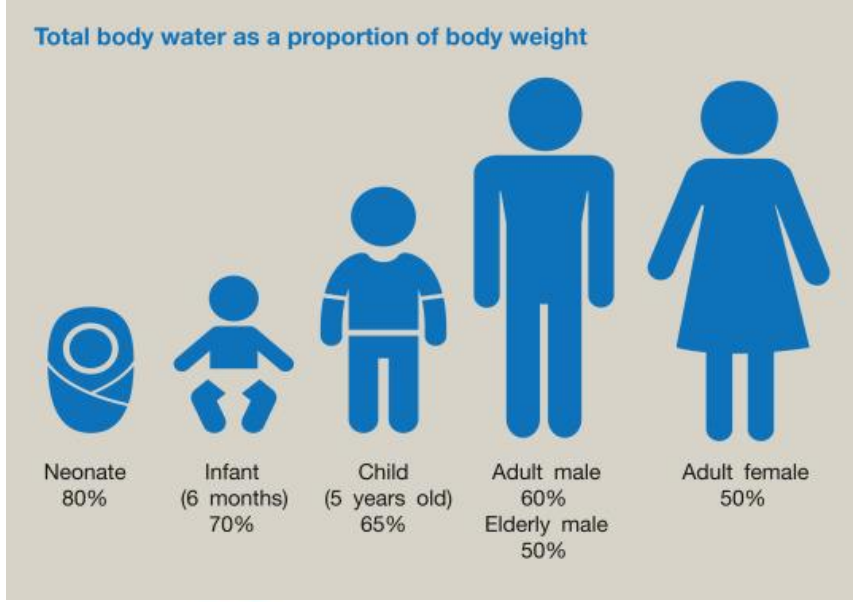
Kemijska zgradba organizmov

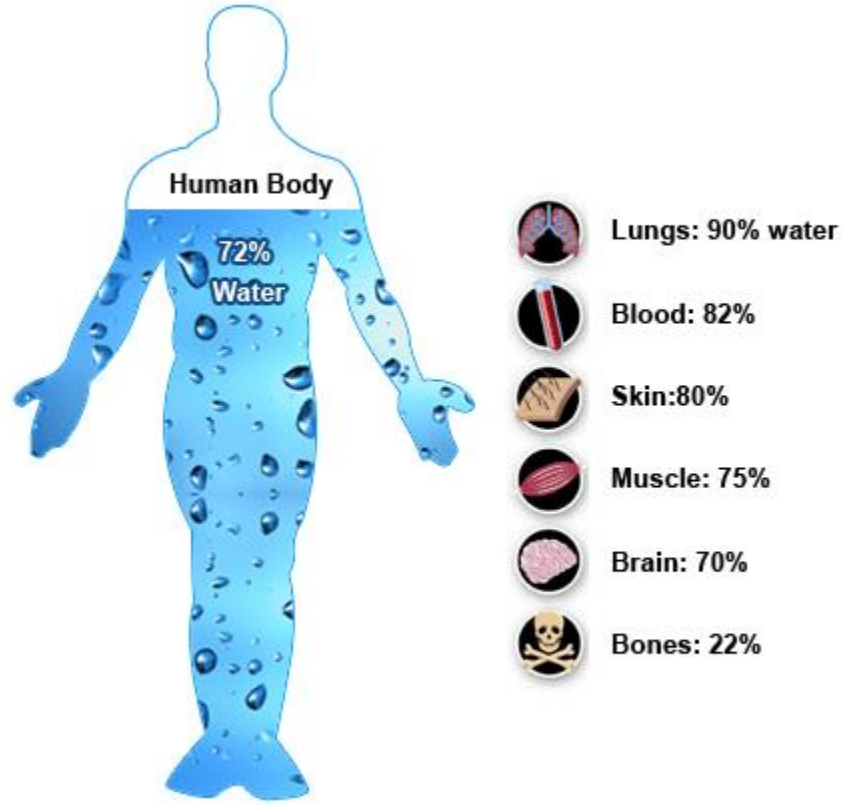
- Snovi v celici so iz molekul, molekule iz atomov.
- Molekule elementa – 2 ali več atomov istega elementa (npr. O_2)
- Spojine – molekule zgrajene iz atomov različnih elementov (npr. H_2O)
- Organske molekule: spojine Iz C, H, N, O, P, S → najpomembnejši makroelementi
- Anorganske molekule (npr. CO_2, CO, NH_3, H_2S, SO_2, H_20, H_2O_2;…)

Voda, vir življenja

- 2 atoma vodika vezana na atom kisika s kovalentno vezjo.
- Polarna molekula
- Kisik – negativni naboj
- Vodik – pozitivni naboj

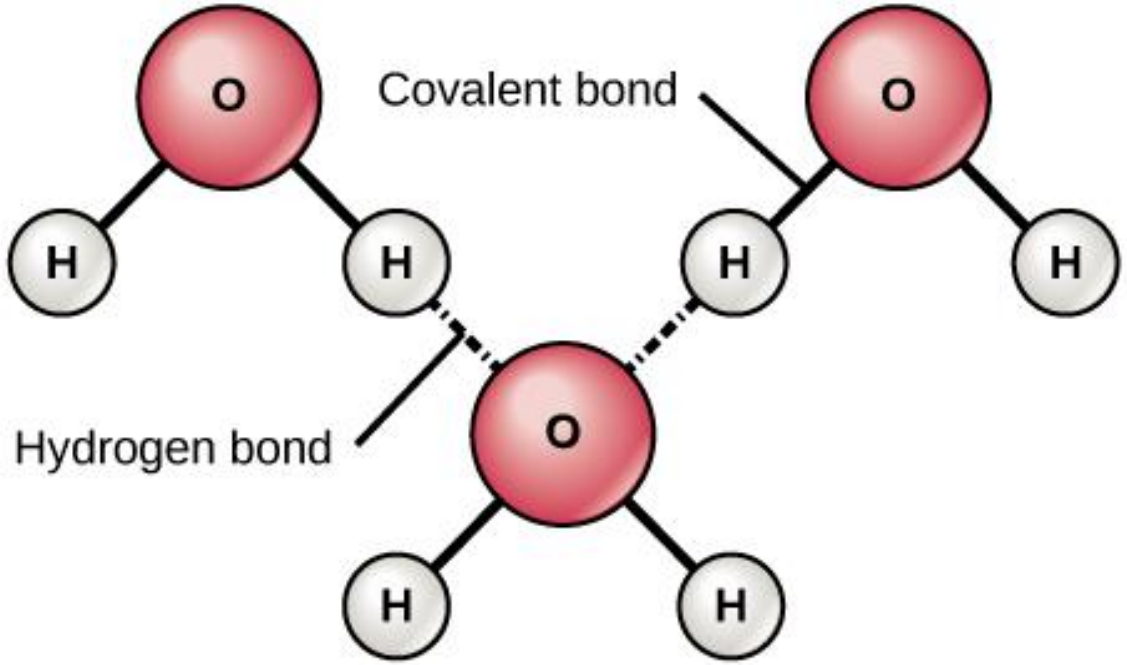


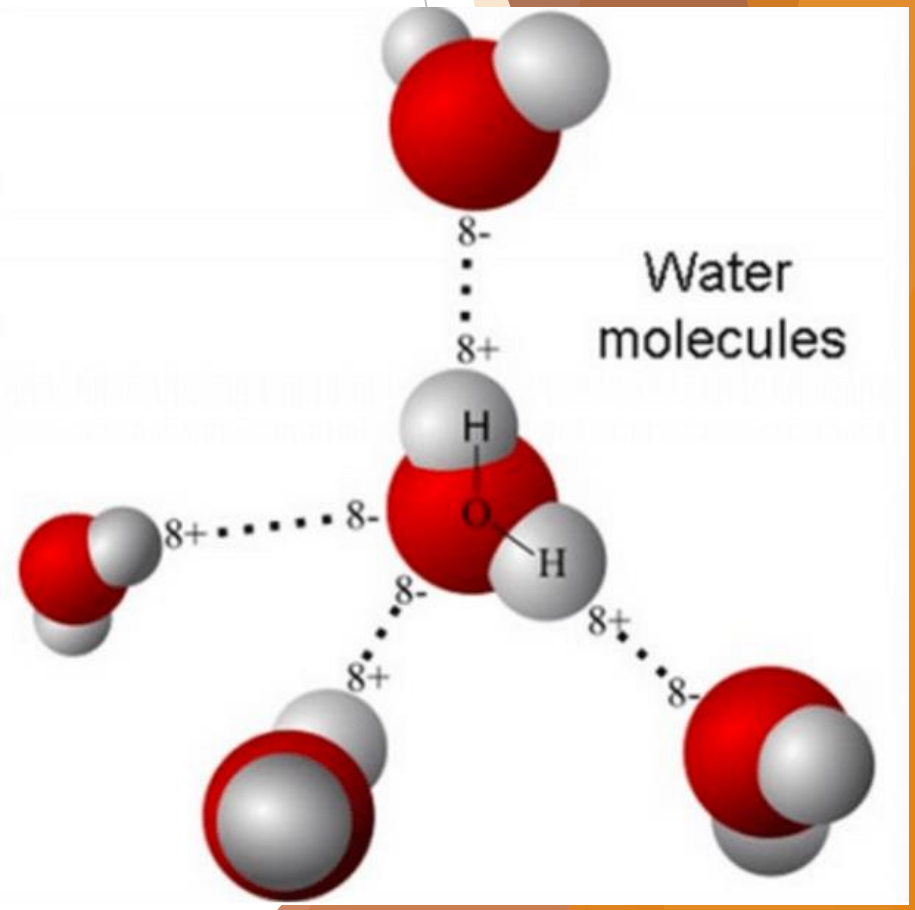




Voda, vir življenja

- Povezovanje molekul vode med seboj z vodikovimi vezmi (4)





Voda kot topilo

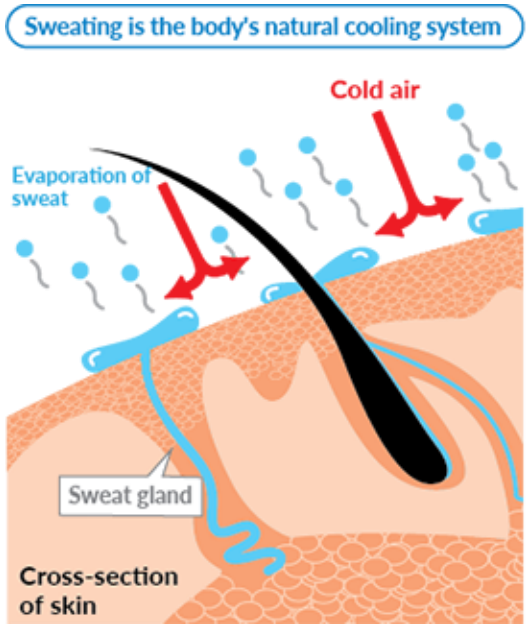
- Za polarne in ionske spojine
- Topilo + topljenec = raztopina
- HIDRATACIJSKI OVOJ
- VEZANA VODA / PROSTA VODA
- Hidrofilne molekule
- Hidrofobne molekule

Gostota in površinska napetost vode

- Max gostota vode pri 4°C (1 kg/dm^3)
- Led ima manjšo gostoto (0,915 kg/dm^3) → plava na vodi
- Voda ima visoko površinsko napetost

Specifična toplota vode

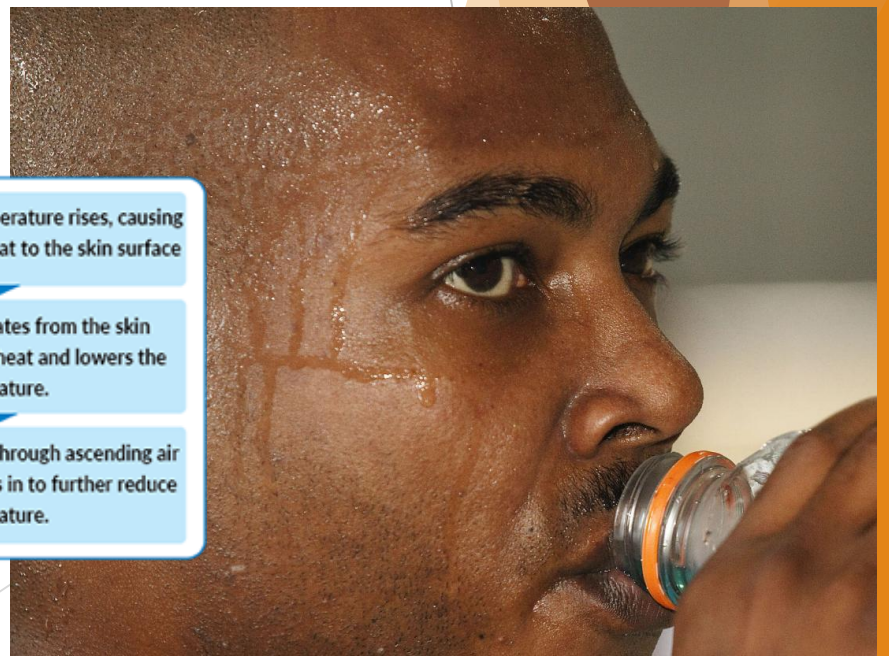
- Velika specifična toplota vode
- Za segrevanje 1kg vode za 1°C je potrebno veliko energije (4,2 kJ)
- Pri ohlajanju se odda veliko energije
- Segrevanje in ohlajanje poteka počasi (morja, oceani) → stabilno življenjsko okolje za organizme
- Izhlapevanje vode



When active, the body temperature rises, causing sweat glands to secrete sweat to the skin surface

When the sweat evaporates from the skin surface, it takes away the heat and lowers the body temperature.

Evaporated sweat escapes through ascending air currents. New cold air flows in to further reduce body temperature.

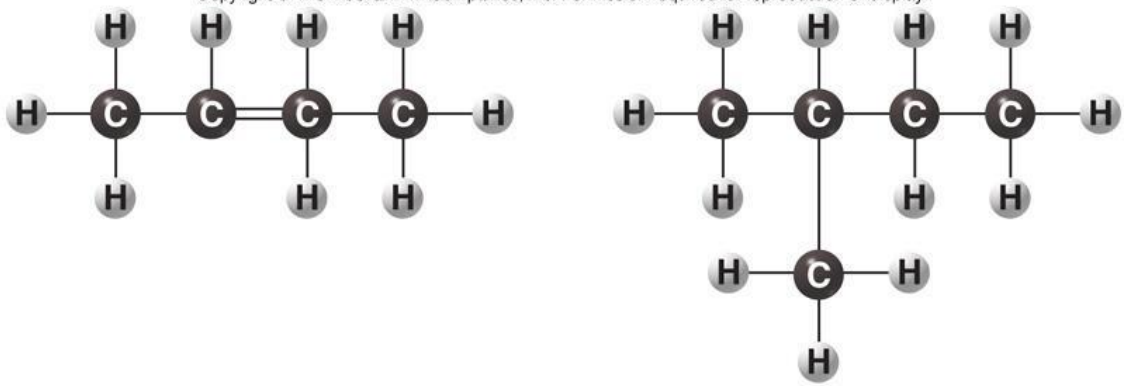


Organske molekule – gradniki življenja

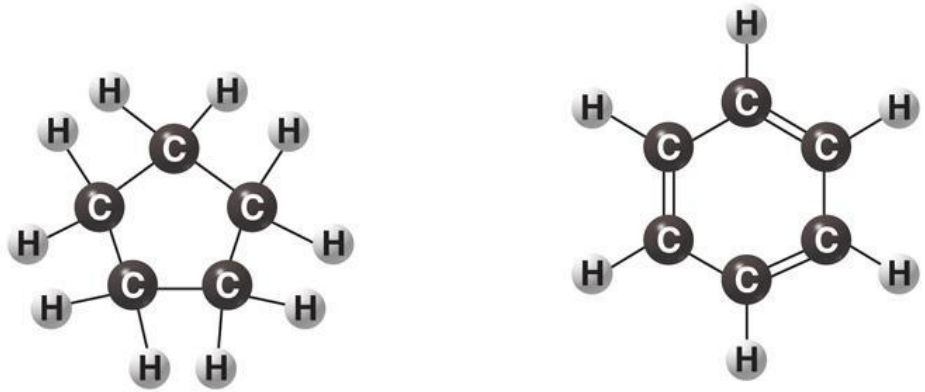
- Pomemben element je C
- Tvorba 4 vezi z drugimi atomi v vse 4 smeri
- Povezovanje C atomov med seboj

  → ogljikovo ogrodje
- Oblika ogljikovega ogrodja:

- Dolžina
- Razvejanost
- Vezi
- Tvorba obročev

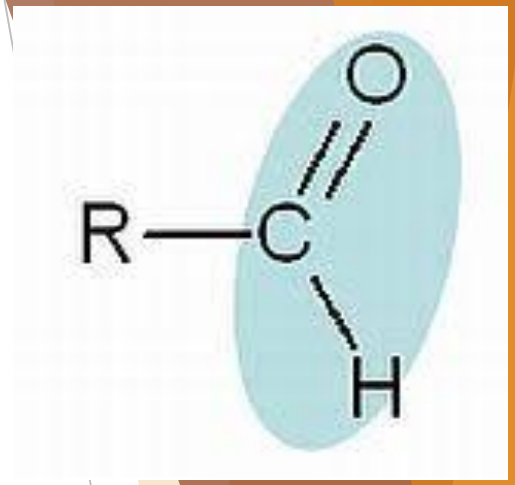


Carbon chains can vary in length, and/or have double bonds, and/or be branched.

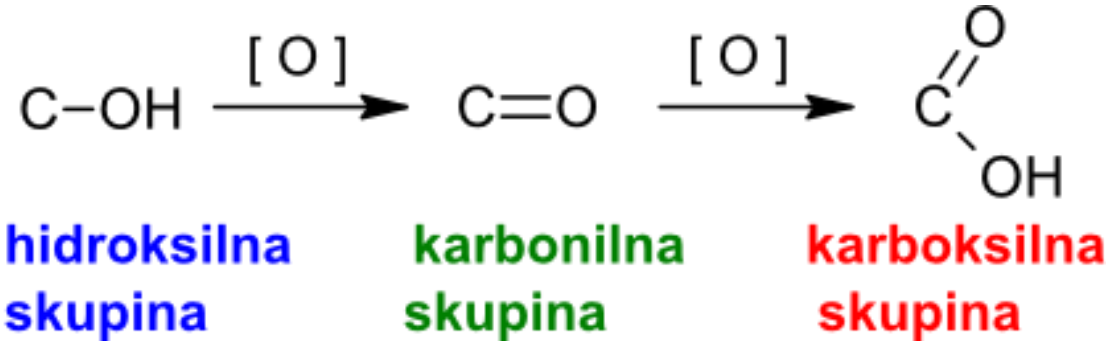


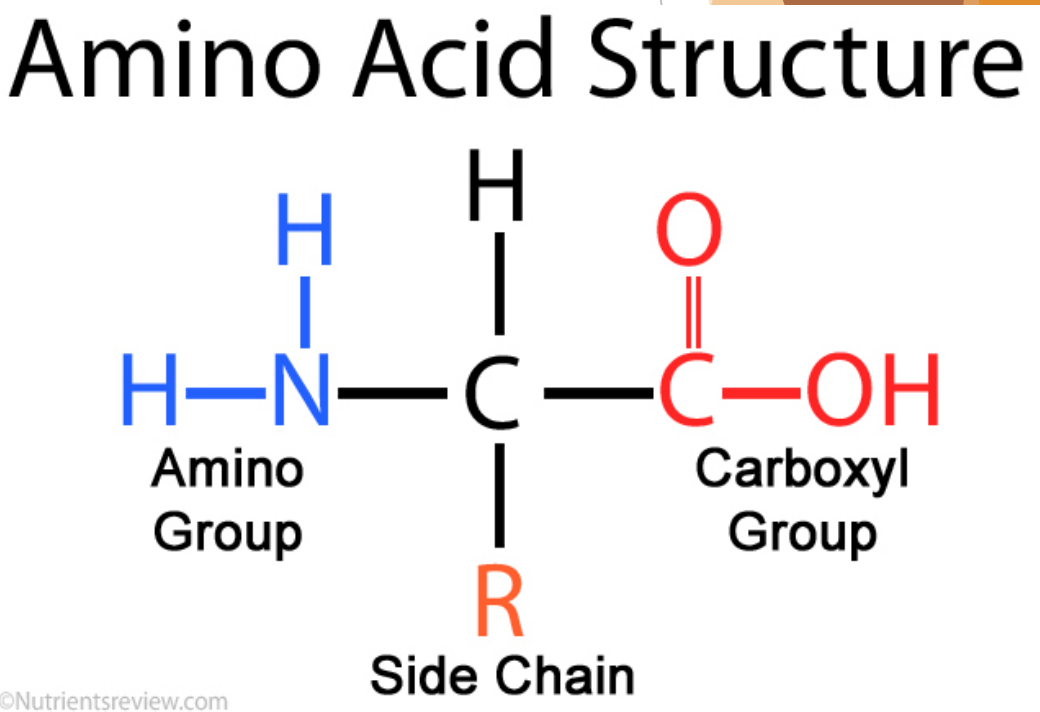
Carbon chains can form rings of different sizes and have double bonds.

Organske molekule



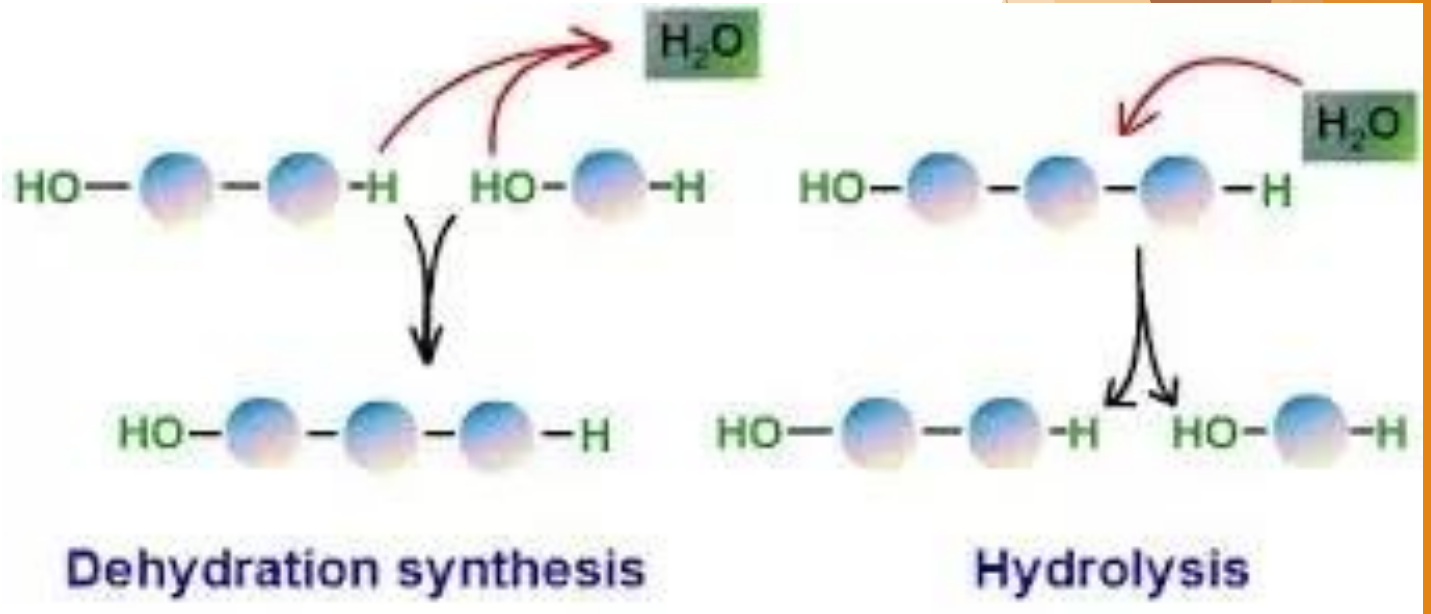
- Funkcionalne skupine → skupine atomov v organskih molekulah, ki sodelujejo v kem. reakcijah in dajejo spojinam značilne kem. lastnosti
- Hidroksilna skupina
- Karbonilna skupina
- Aminska skupina
- Karboksilna skupina
- Aldehidna skupina





Organske molekule

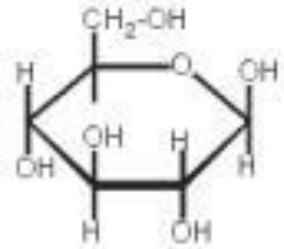
- Makromolekule
- Osnovni gradnik → MONOMER (npr. glukoza)
- POLIMER →(npr. škrob)
- Polimerizacija
- Izgradnja (nastanek) polimera – dehidracija (kondenzacijska polimerizacija)
- Razgradnja polimera - hidroliza

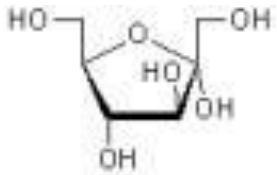


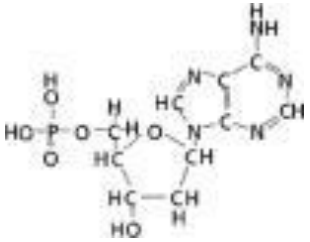
GRADBENE ZNAČILNOSTI ORG. MOLEKUL

MONOMERI – BIOMONOMERI

nizka molekularna masa

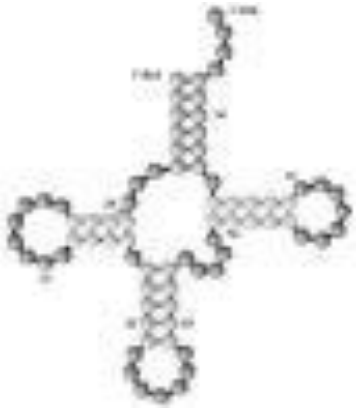


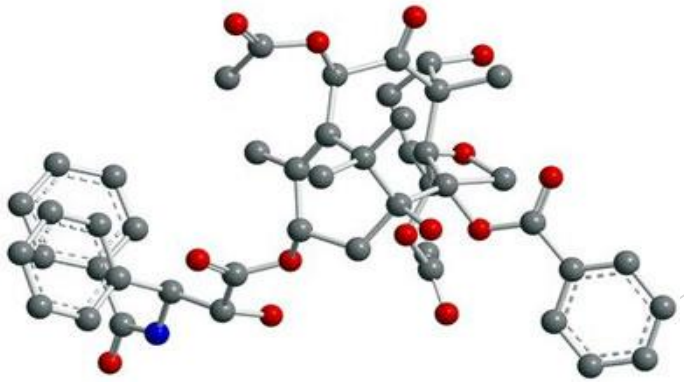




POLIMERI – BIOPOLIMERI

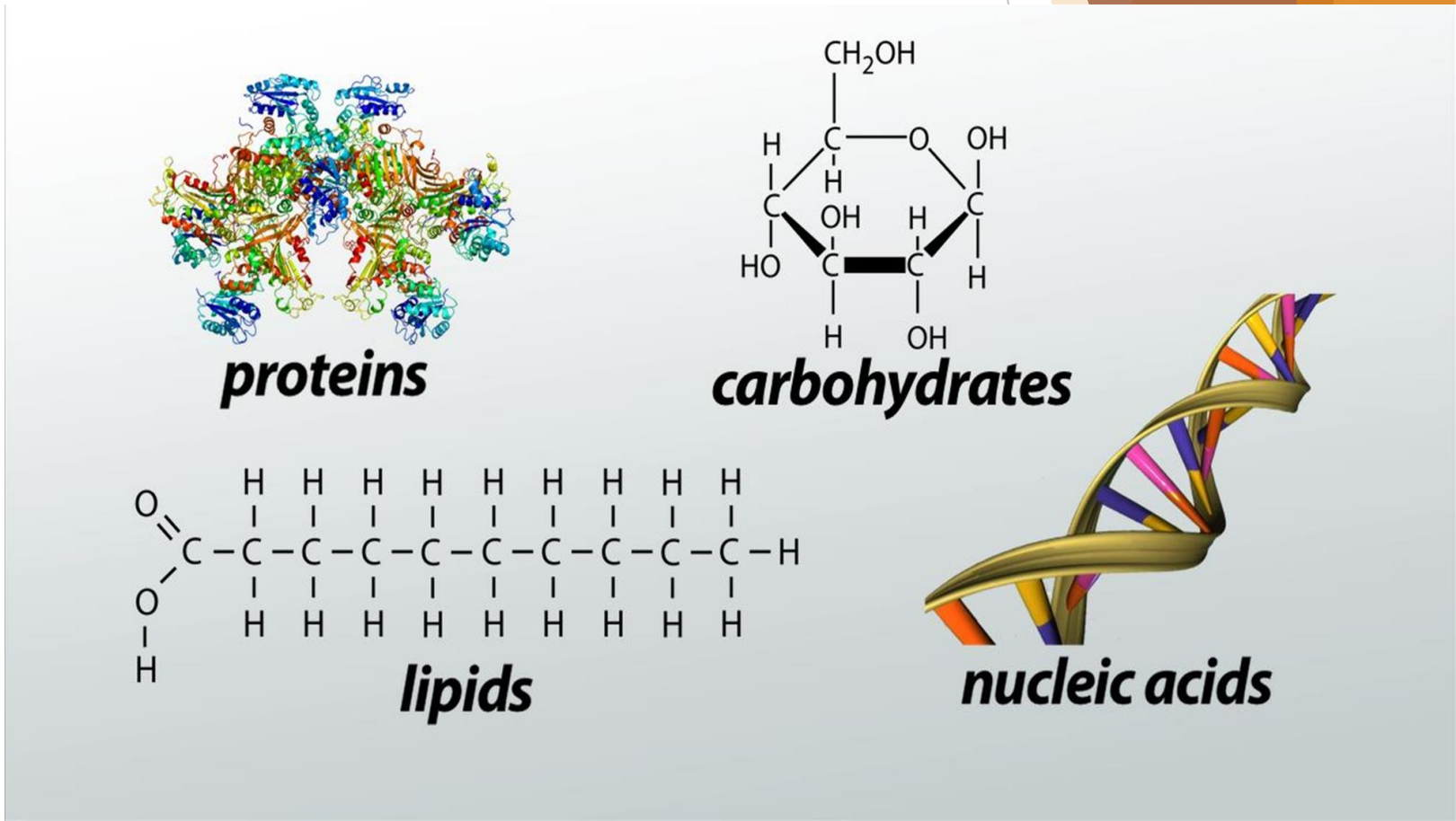
visoka molekularna masa





Osnovne skupine organskih molekul

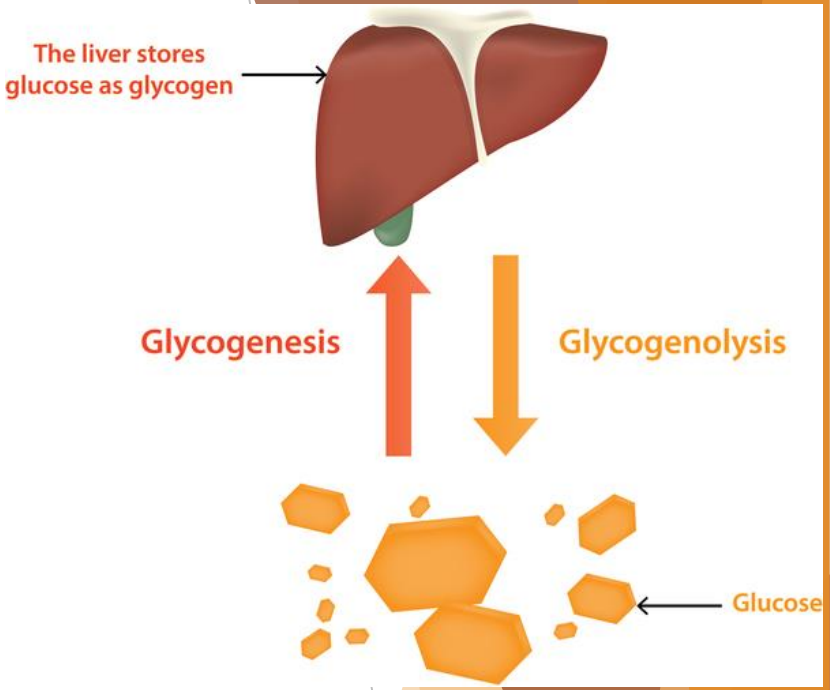
- OGLJIKOVI HIDRATI
- BELJAKOVINE (PROTEINI)
- MAŠČOBE (LIPIDI)
- NUKLEINSKI KISLINE



OGLJIKOVI HIDRATI

- Vir E
- Oporni gradbeni material v organizmih
- Gradniki drugih org. molekul
- Zgrajeni iz C, H in O v razmerju 1:2:1

POMEN OGLJIKOVIH HIDRATOV:



- ENERGETSKA ZALOGA: škrob in glikogen

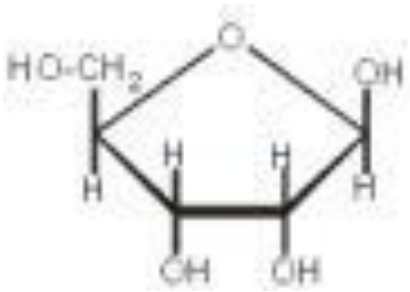
- SPROTEN VIR ENERGIJE : fruktoza, glukoza

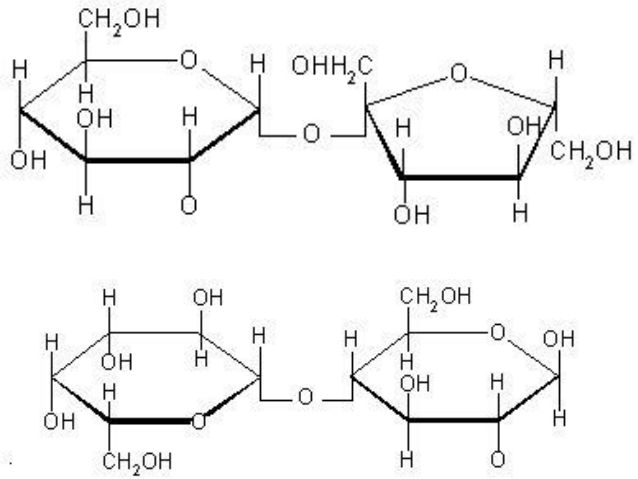
- GRADBENI MATERIAL: hitin, celuloza

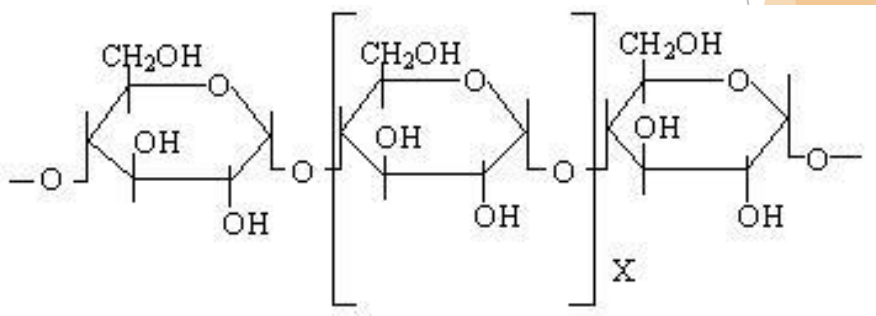
OGLJIKOVI HIDRATI (CH)

- Delitev CH glede na število C atomov

MONOSAHARIDI ⟶ DISAHARIDI ⟶ POLISAHARIDI

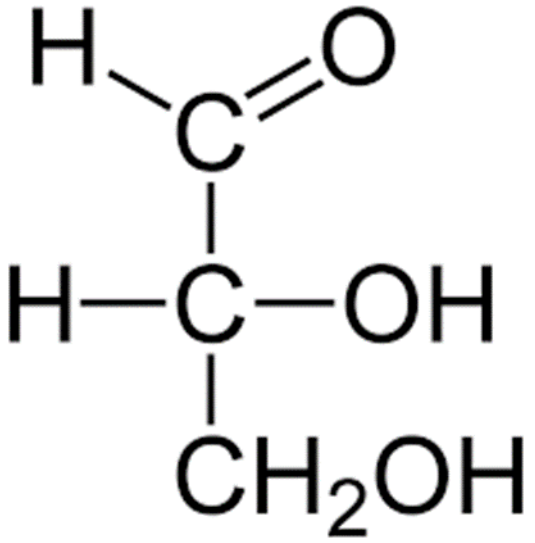


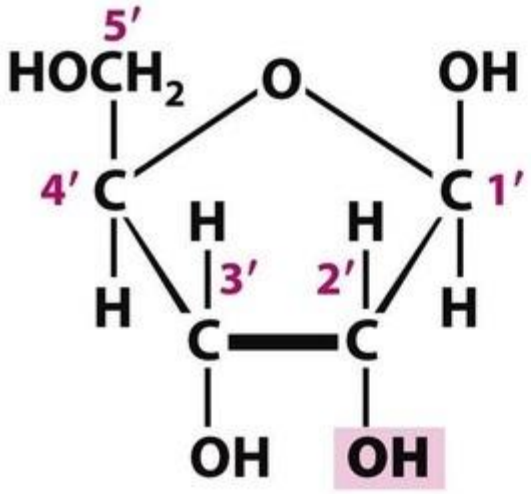




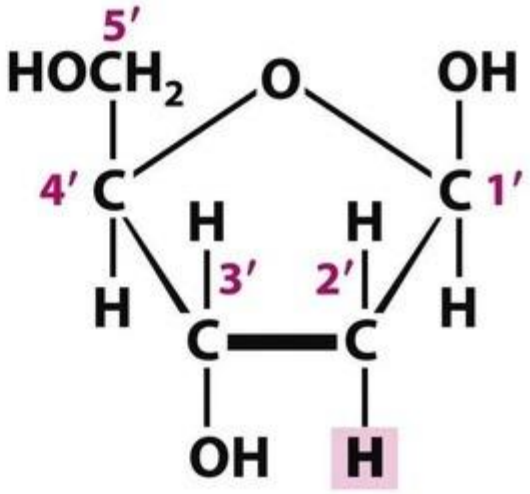
MONOSAHARIDI

- MONOSAHARIDI – najpreprostejši CH
- Ogljikovo ogrodje → 3-10 C atomov
- Trioze (3C atomi) – gliceraldehid
- Pentoze (5C atomov) – riboza, deoksiriboza

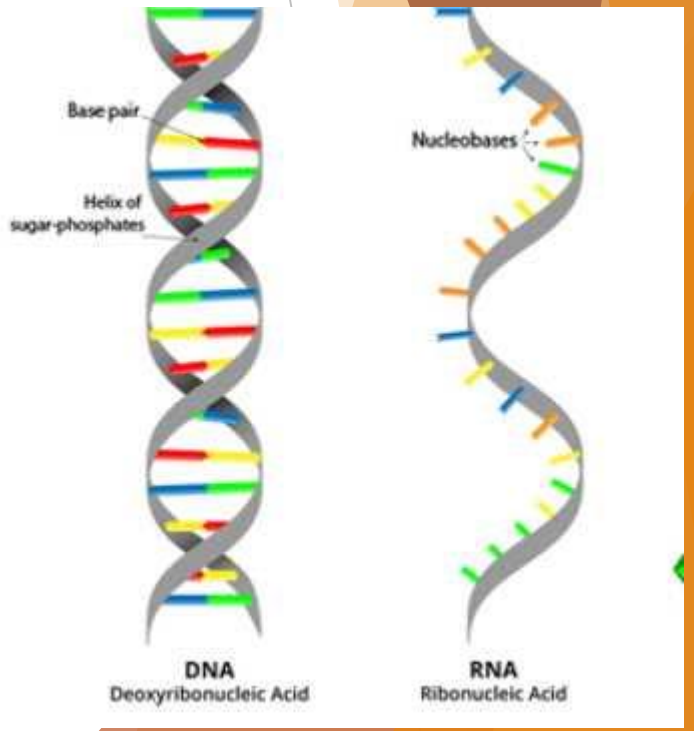




Ribose

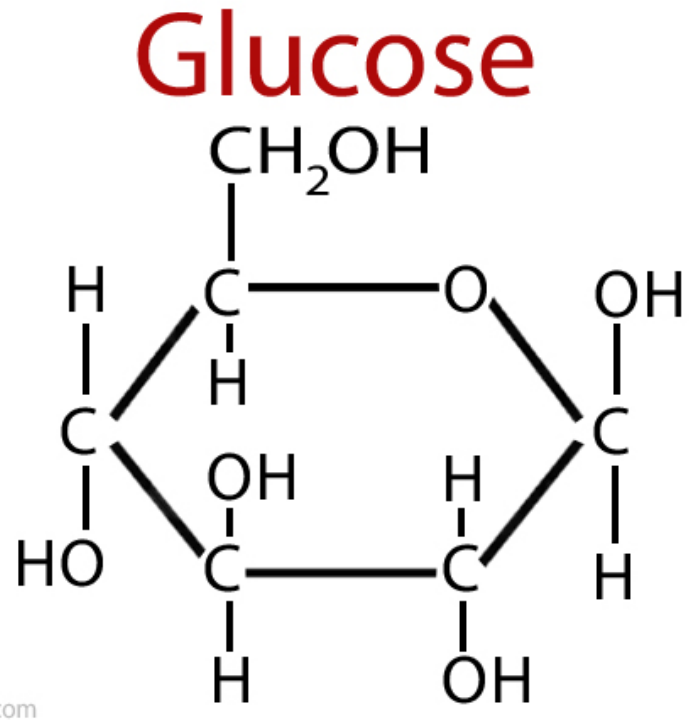


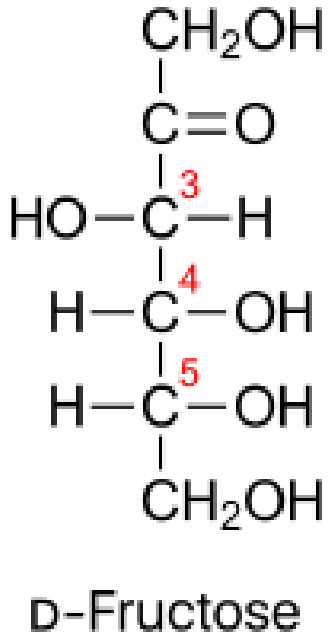
Deoxyribose

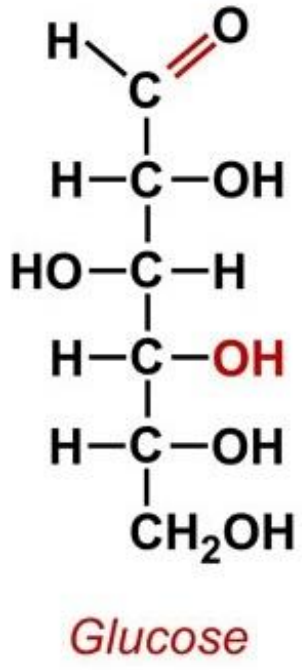


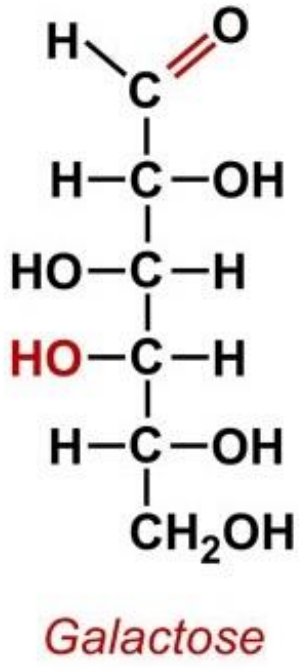
MONOSAHARIDI

- Heksoze (6C atomov): glukoza, galaktoza, fruktoza



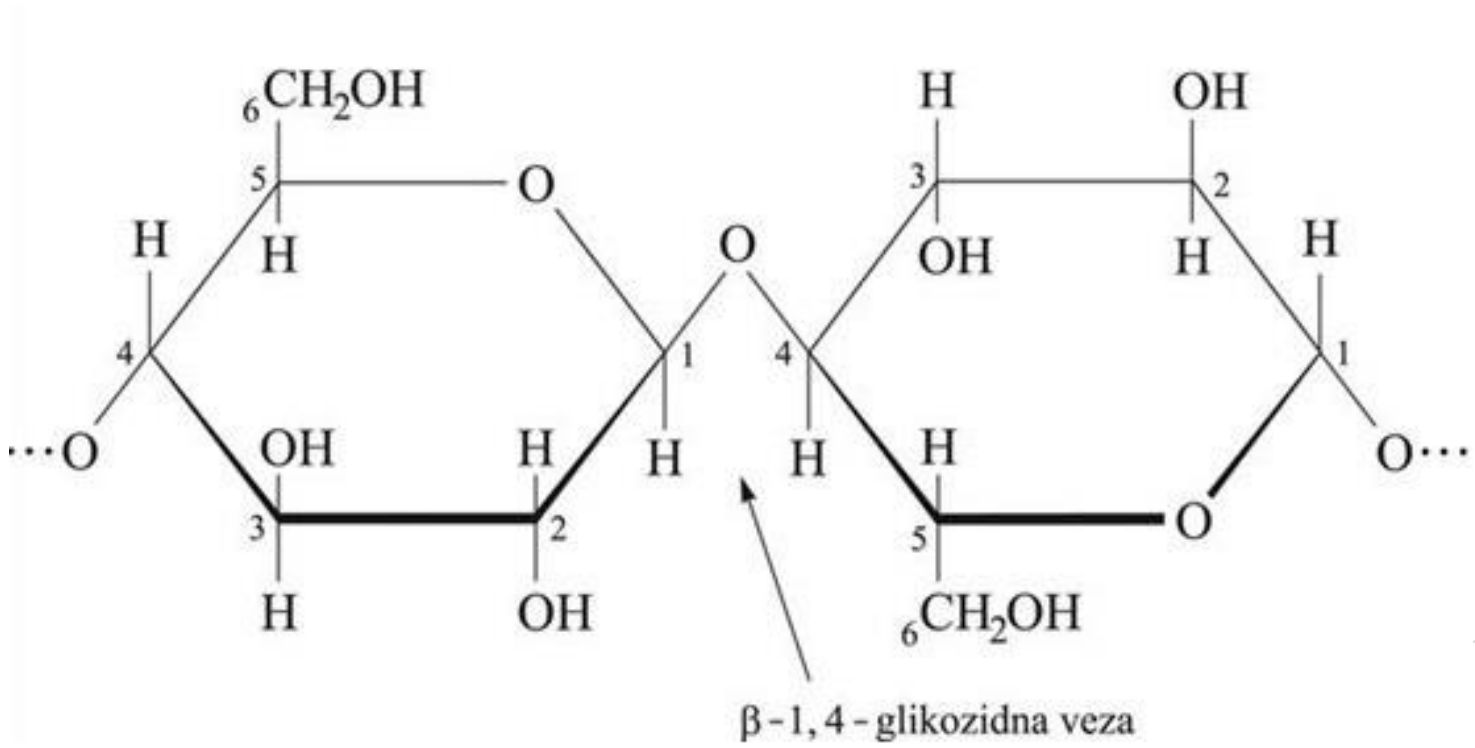






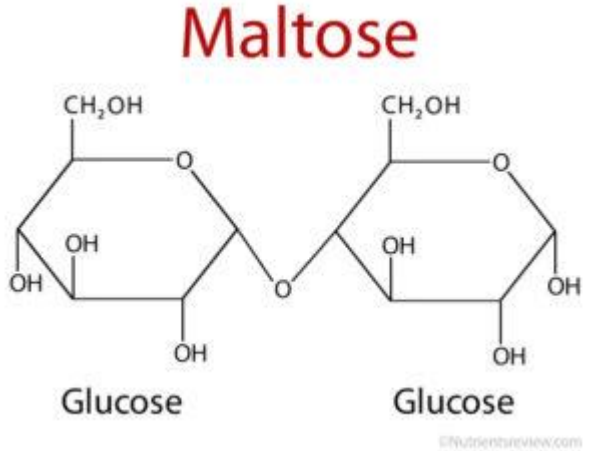
Sestavljeni sladkorji

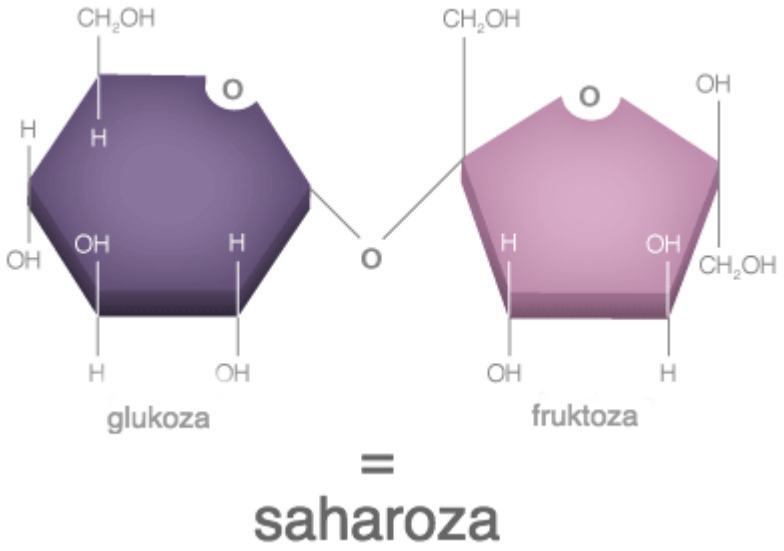
- Iz dveh ali več monomernih enot
- DISAHARIDI
- POLISAHARIDI

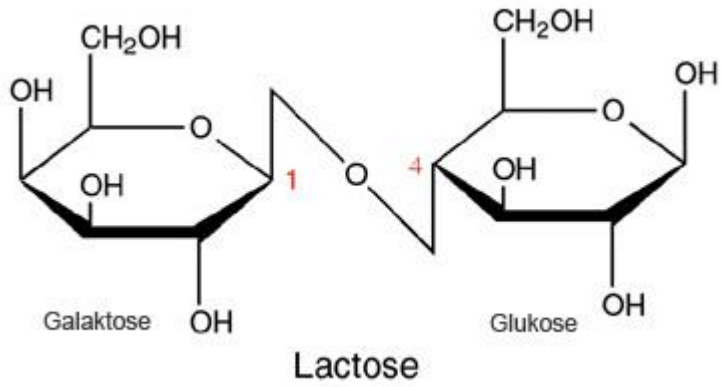


DISAHARIDI

- SAHAROZA = GLUKOZA + FRUKTOZA
- LAKTOZA = GLUKOZA + GALAKTOZA
- MALTOZA = GLUKOZA + GLUKOZA

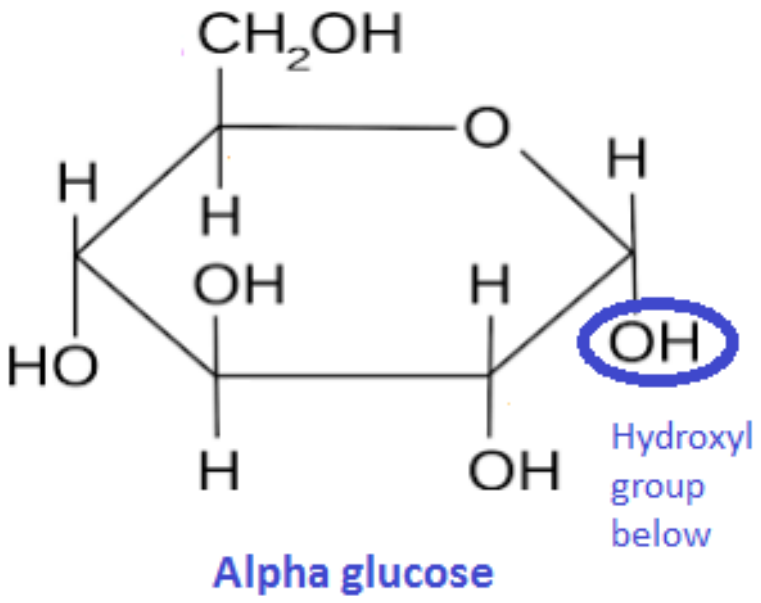




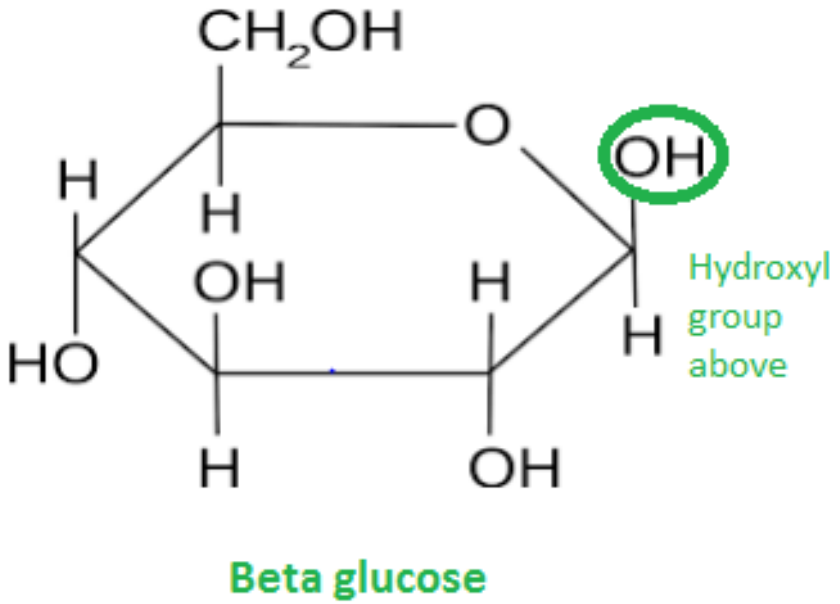


POLISAHARIDI

- Iz več enakih ali različnih monomernih enot
- Pomembna je razlika v organizaciji glukoznega obroča (alfa in beta glukoza)



Alpha glucose



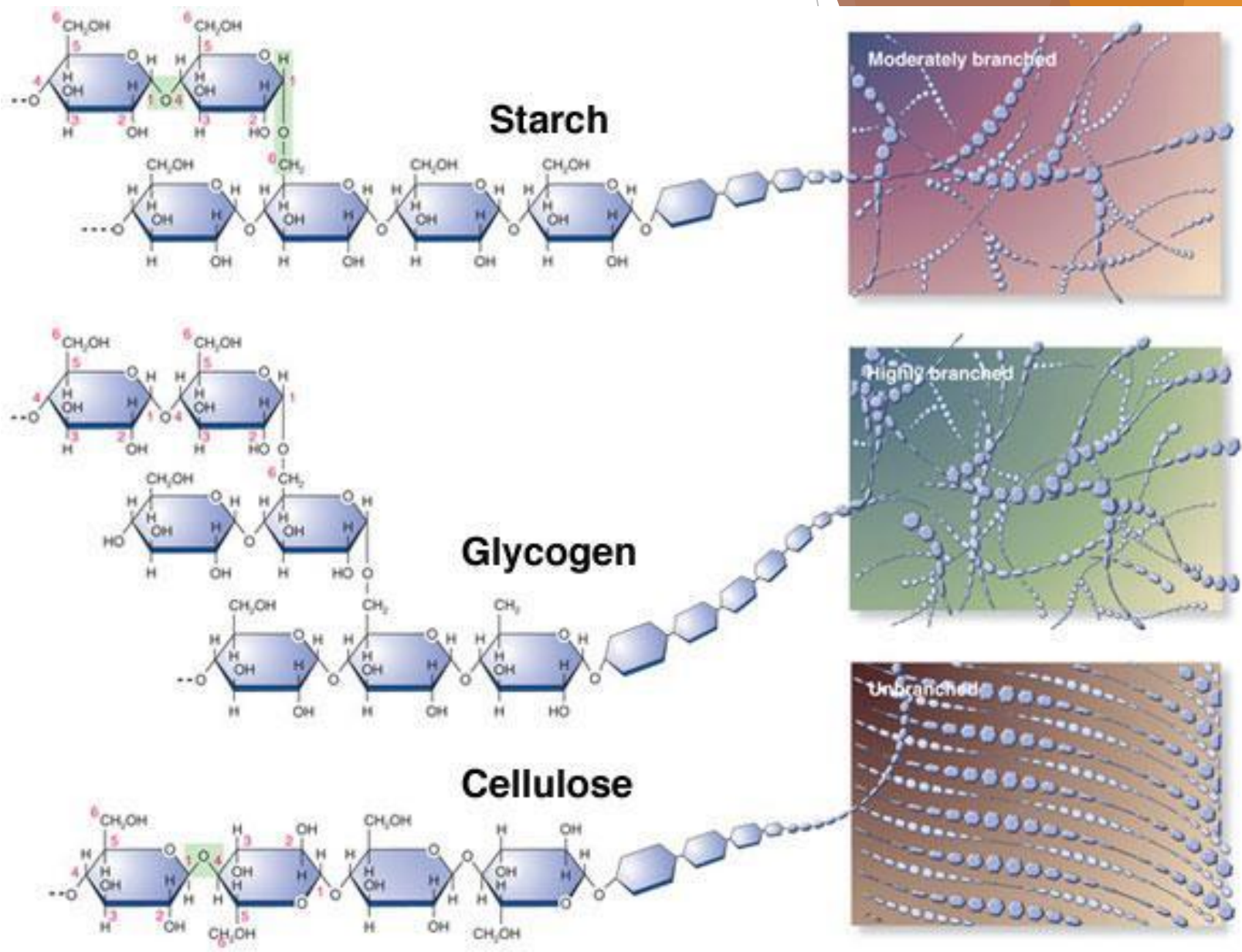
Beta glucose

POLISAHARIDI

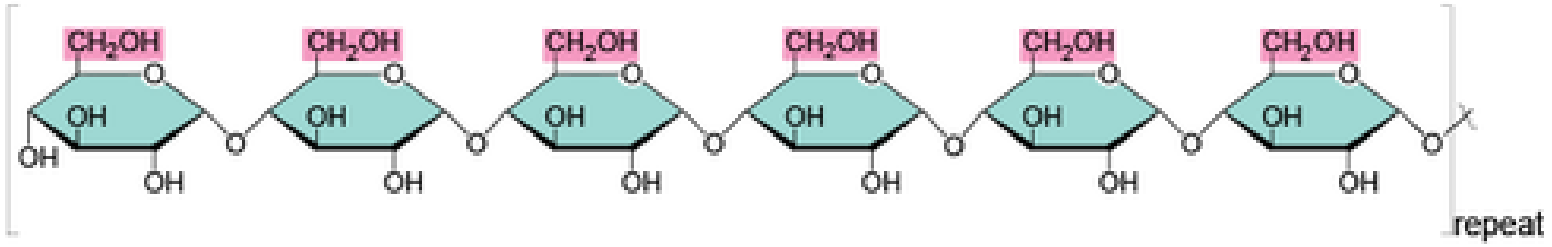
- Alfa glukoza osnovni gradnik

  škroba in glikogena
- Beta glukoza osnovni gradnik

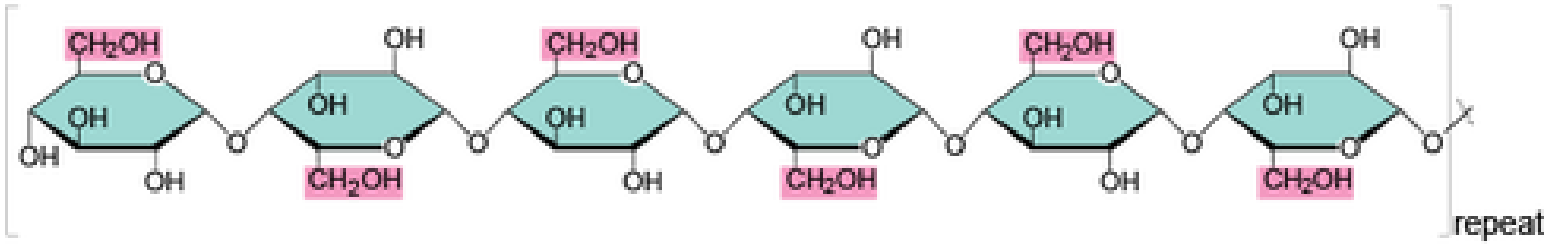
  celuloze



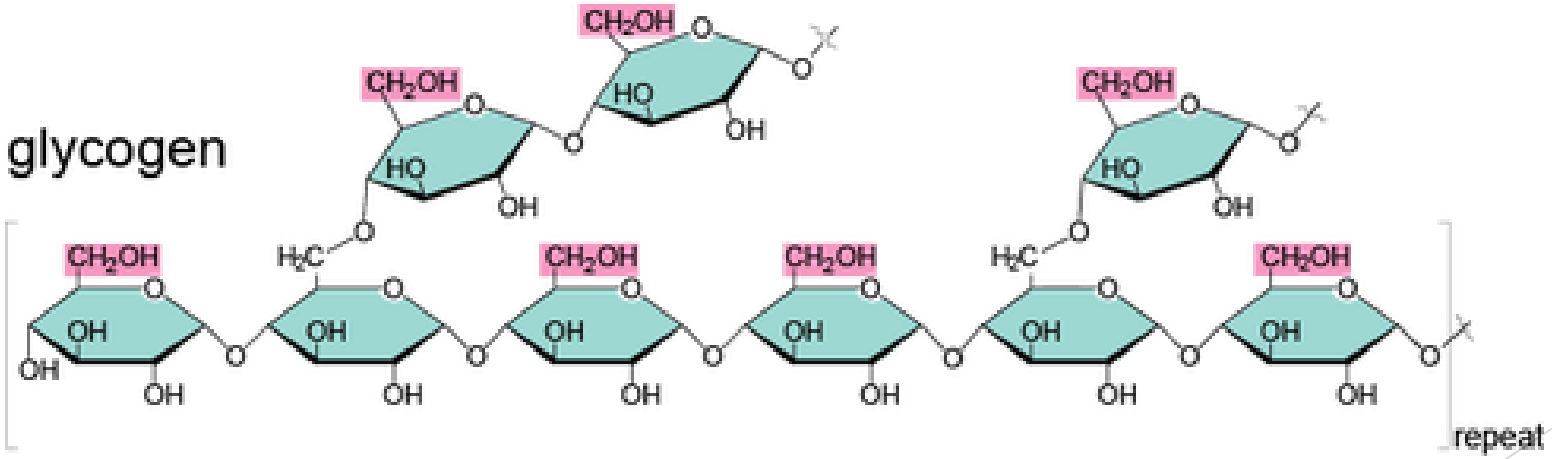
starch

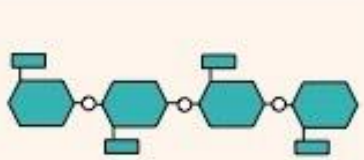
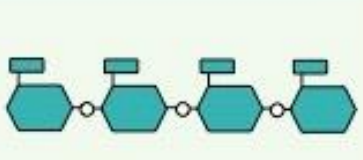
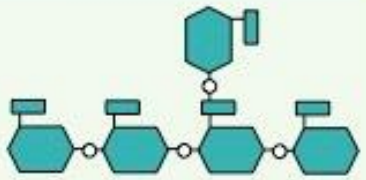
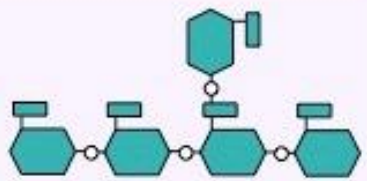
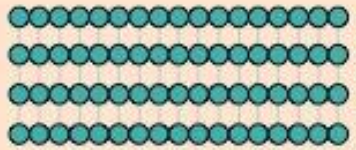
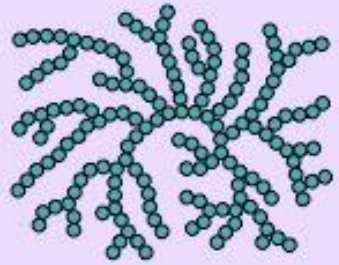


cellulose



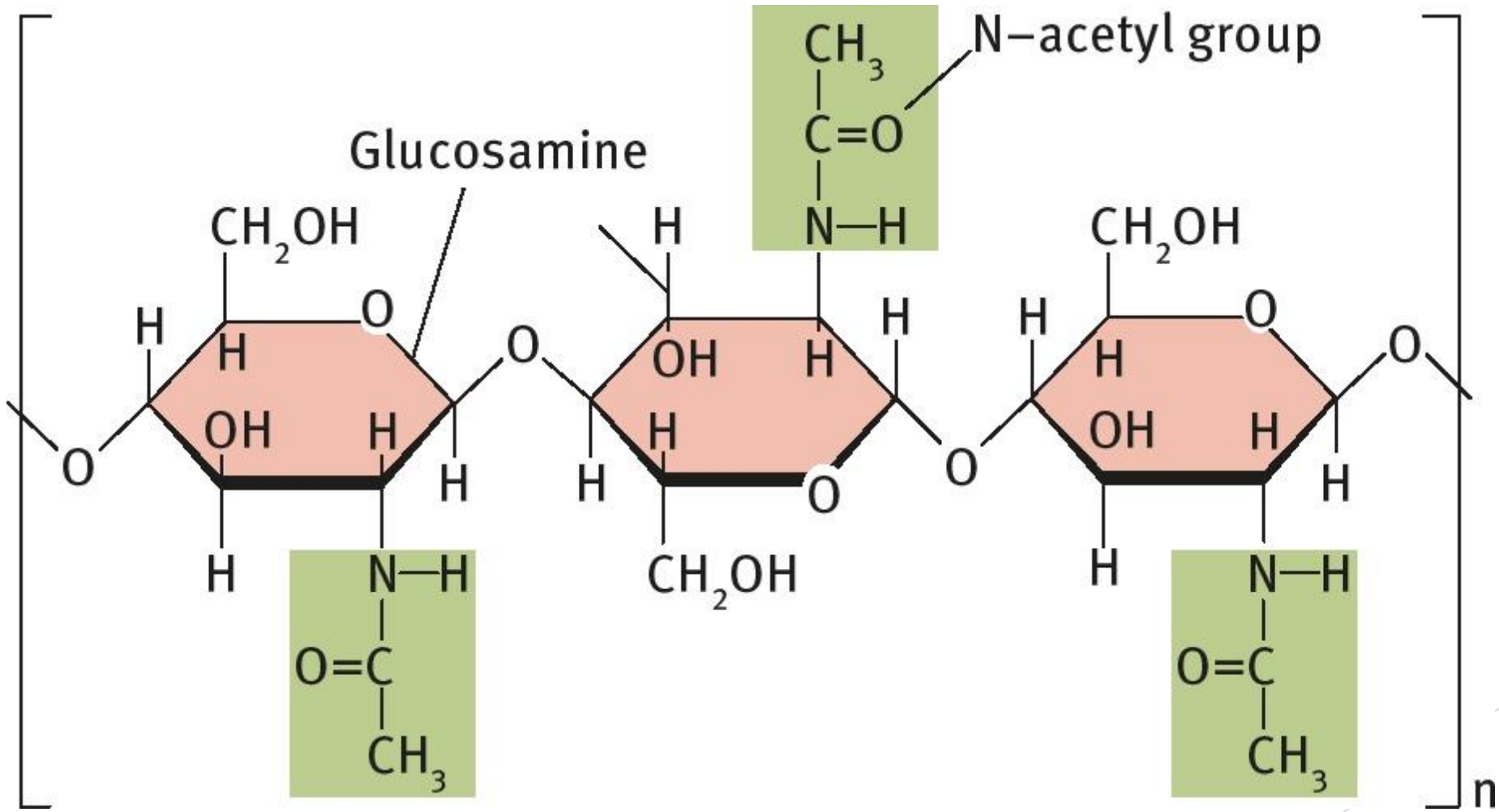
glycogen



	Cellulose	Starch		Glycogen
		Amylose	Amylopectin	
Source	Plant	Plant	Plant	Animal
Subunit	β-glucose	α-glucose	α-glucose	α-glucose
Bonds	1-4	1-4	1-4 *and* 1-6	1-4 *and* 1-6
Branches	No	No	Yes (~per 20 subunits)	Yes (~per 10 subunits)
Diagram				
Shape				

POLISAHARIDI

- Hitin
- Zunanje ogrodje členonožcev (raki, žuželke)
- Celične stene gliv


N–acetyl group
Glucosamine
n

BELJAKOVINE (PROTEINI)

- Obsežna skupina organskih molekul
- Do 5000 različnih beljakovin v vsaki celici
- Ena celica vsebuje cca 42 milijonov proteinskih molekul
- Dnevne beljakovinske potrebe: 1g/kg telesne teže
- Pomanjkanje beljakovin → motnje v razvoju
  - Manjša mišična masa
  - Slabša presnova
  - Nenehni občutek lakote
  - Pogoste okužbe

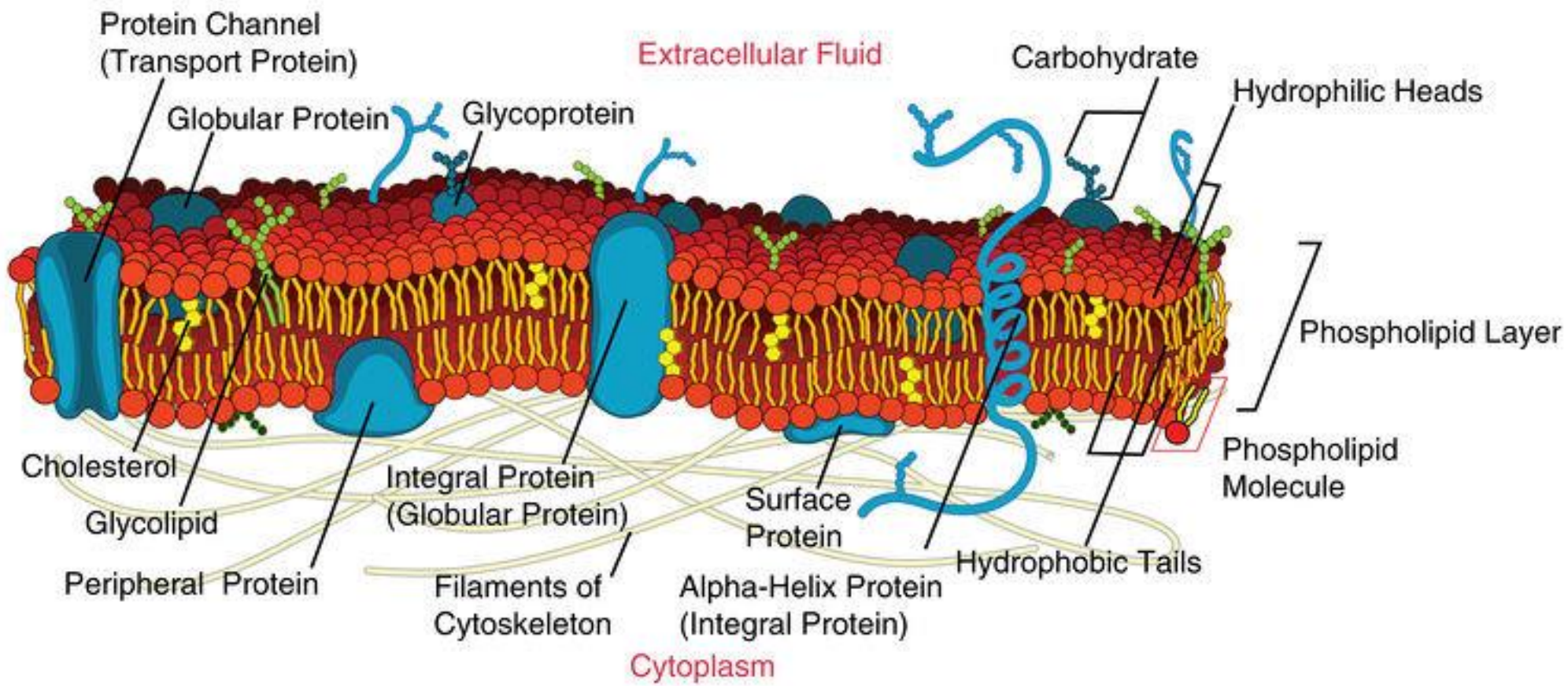
Vrsta beljakovin in njihov vloga

Vrsta beljakovine	Vloga	Primer
Encimi	Pospeševanje kemijskih reakcij	Prebavni encimi v želodcu sodelujejo pri razgradnji hrane
Strukturne beljakovine	Zaščita in opora	Keratin je osnovna sestavina las, nohtov, perja
Založne beljakovine	Zaloga AK	Beljak v jajcu je zaloga AK za zarodek
Transportne beljakovine	Prenos snovi in plinov	Hemoglobin v erc prenaša kisik po telesu
Receptorske beljakovine	Prepoznavanje in vezava drugih molekul	Sprejemanje in prenašanje živčnih signalov med celicami
Motorične beljakovine	Krčenje in premikanje	Omogočajo krčenje mišičnih celic

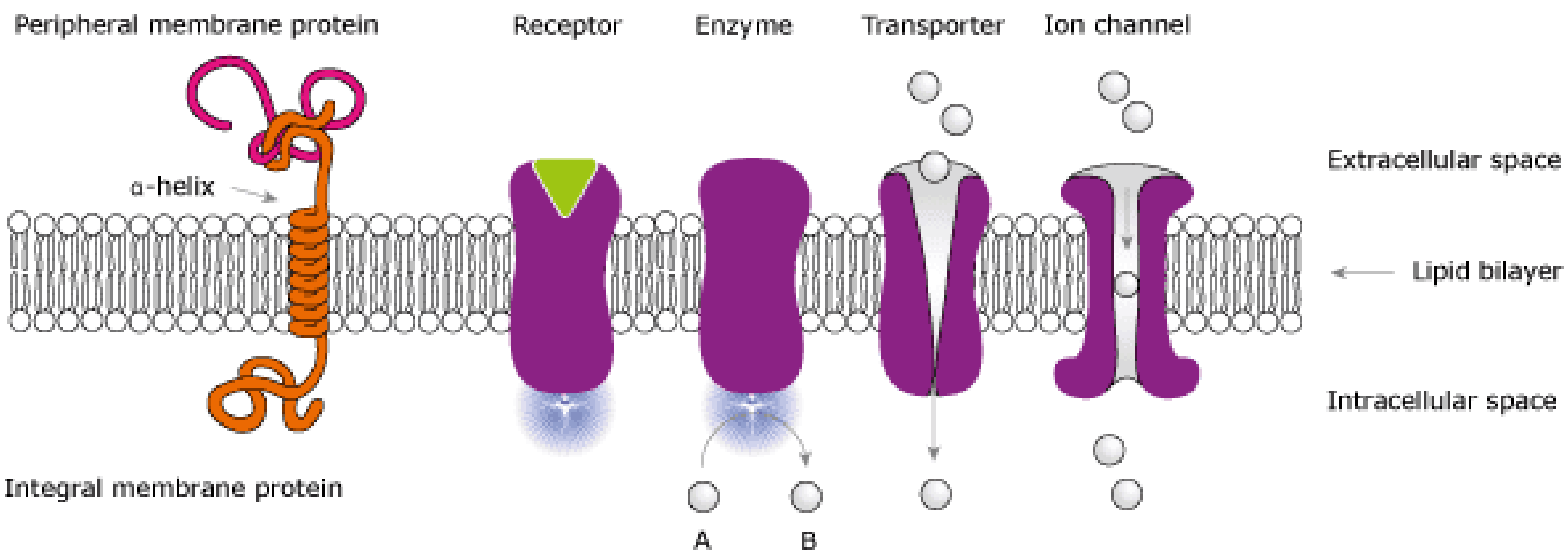
Primeri beljakovin

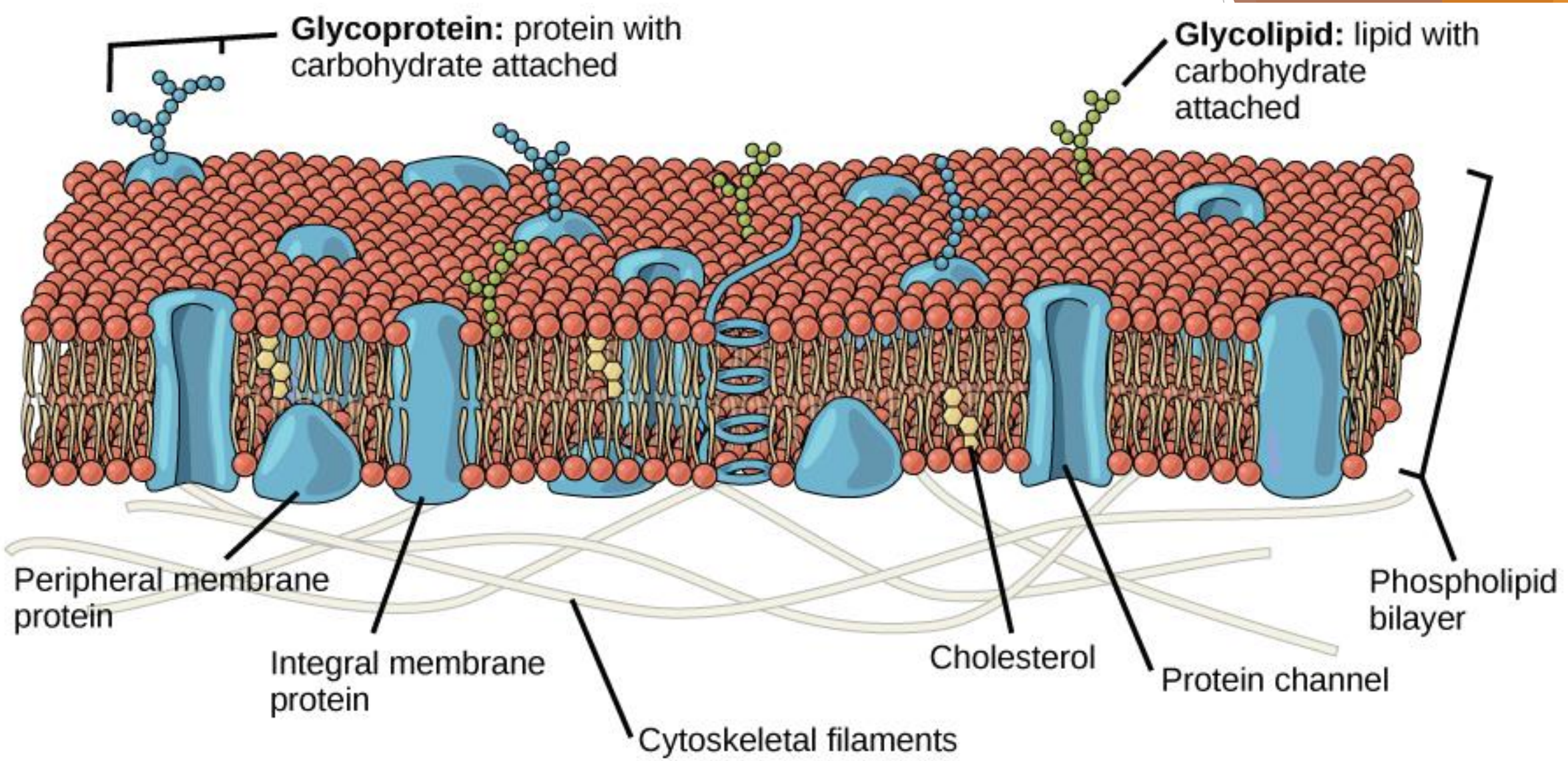
- Hemoglobin – prenaša kisik po krvi
- Mioglobin – skladišči kisik v mišicah
- Fibrinogen – omogoča strjevanje krvi
- Protitelesa – zaščitne beljakovine
- Antigeni – tuje beljakovine, ki v telesu sprožijo imunski odgovor
- Keratin – v luskah, rogovih, kopitih, nohtih
- Kolagen – v vezivnem tkivu kože
- Pepsin – prebavni encim za razgradnjo proteinov
- Lipaza – prebavni encim za razgradnjo maščob

So sestavni del celičnih membran



Vrste membranskih proteinov



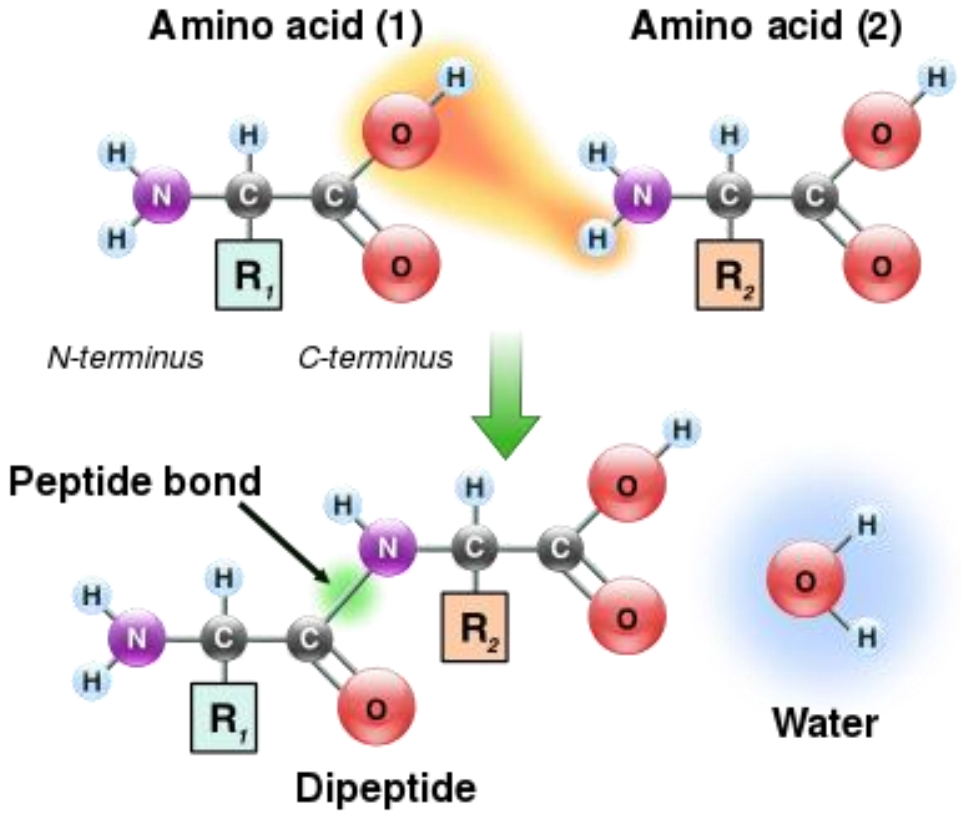

Glycoprotein: protein with carbohydrate attached
Glycolipid: lipid with carbohydrate attached
Peripheral membrane protein
Integral membrane protein
Cytoskeletal filaments
Cholesterol
Protein channel
Phospholipid bilayer

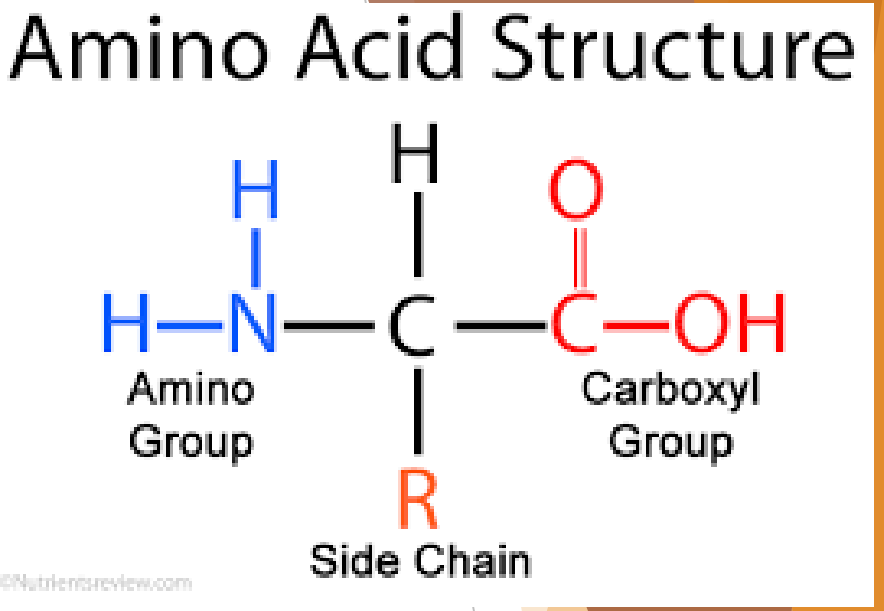
Zgradba beljakovin

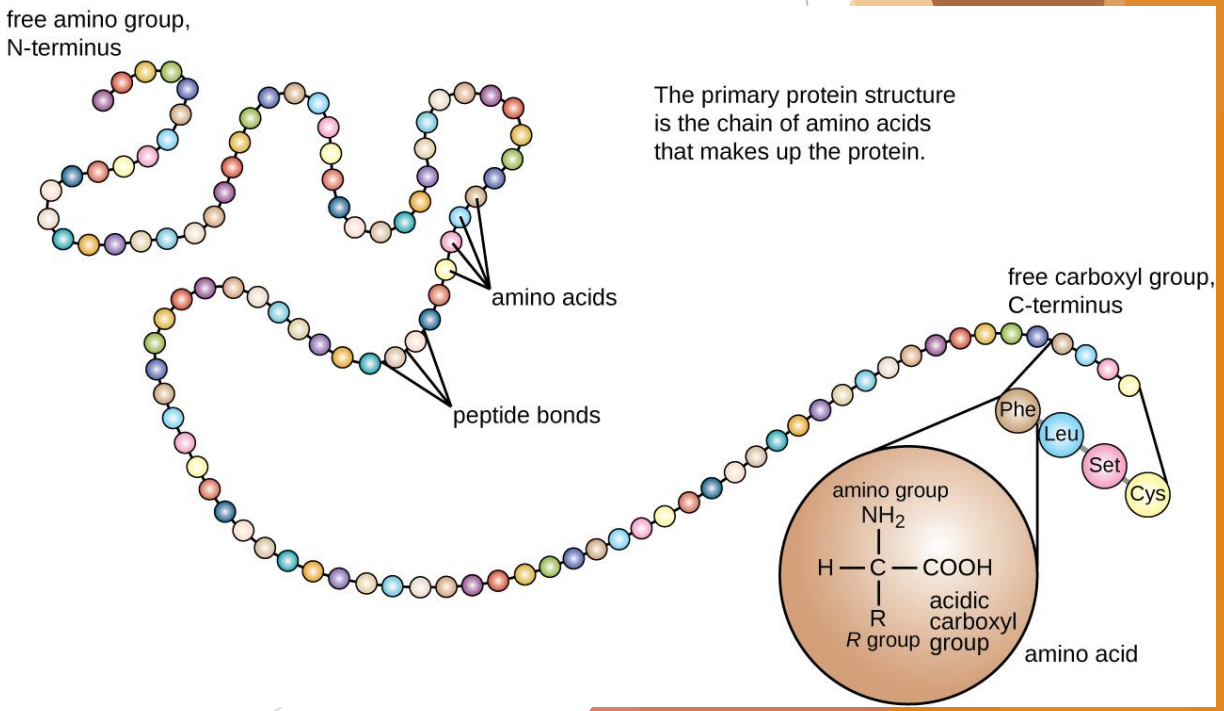
- navodila o zgradbi nosi molekula DNA
- osnovna enota beljakovin je aminokislina (AK)
- zgradba beljakovine je odvisna od zaporedja in števila aminokislin
- beljakovine so polimeri aminokislin

Aminokislina

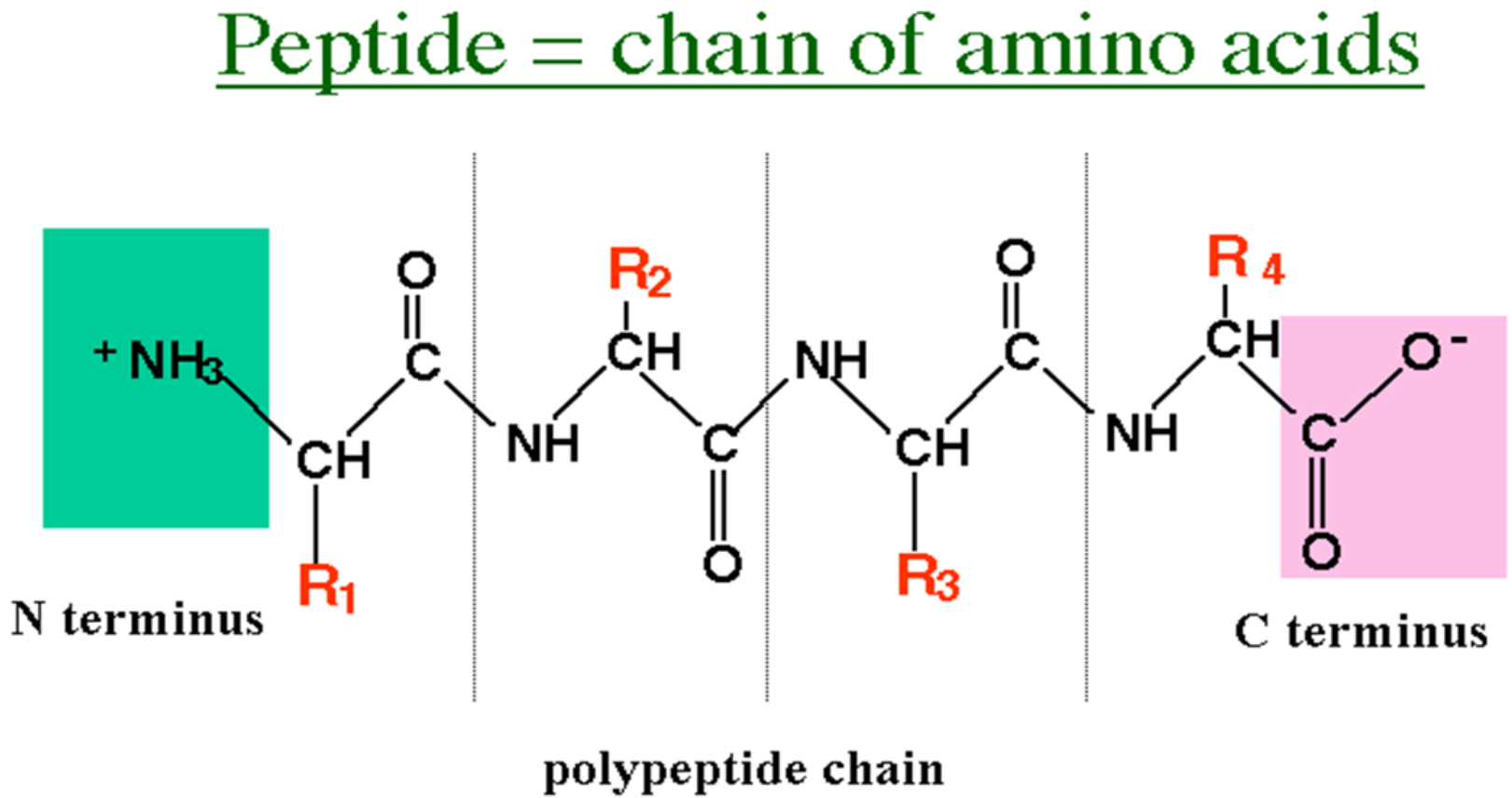
- Amino skupina –NH2
- Karboksilna skupina –COOH
- R skupina (radikal) – spremenljivi del molekule
- Povezovanje AK s peptidno vezjo







Peptidna vez

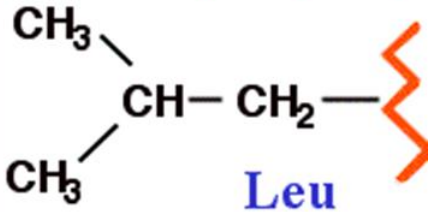
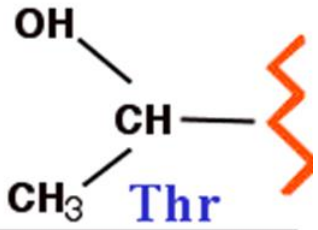
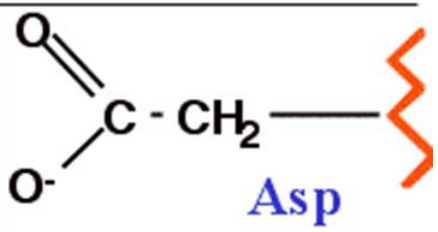
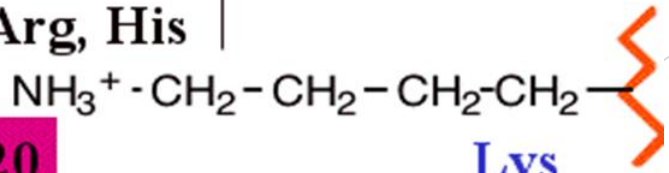


Glede na število aminokislin ločimo …

- DIPEPTID 2 AK
- POLIPEPTID 3 ali več AK
- BELJAKOVINA 50 in več AK

Skupine aminokislin

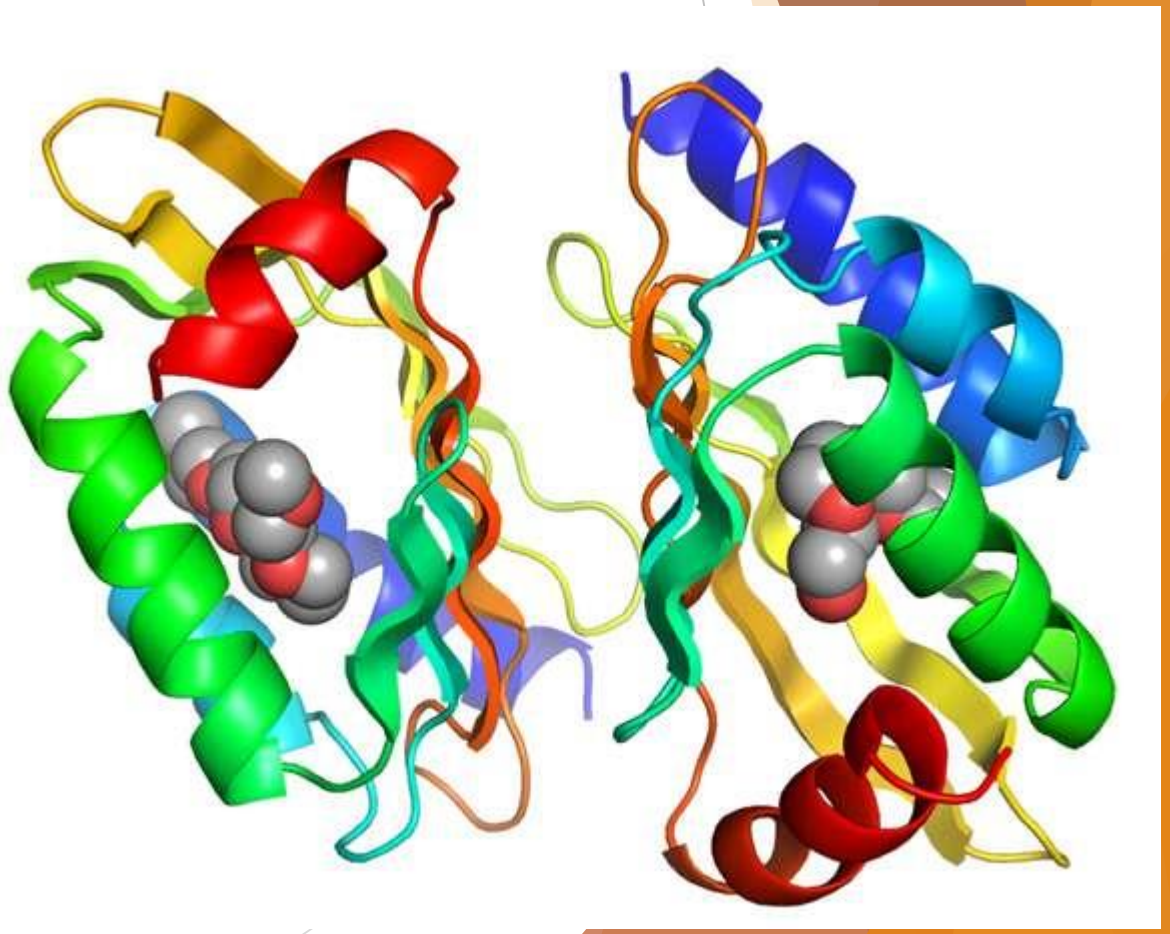
Amino acids groups

Group	Characteristics	Names	Example (-Rx)
non-polar	hydrophobic	Ala, Val, Leu, Ile, Pro, Phe Trp, Met	 Leu
polar	hydrophilic (non-charged)	Gly , Ser, Thr, Cys, Tyr, Asn Gln	 Thr
acidic	negatively charged	Asp, Glu	 Asp
basic	positively charged	Lys, Arg, His	 Lys

Total = 20

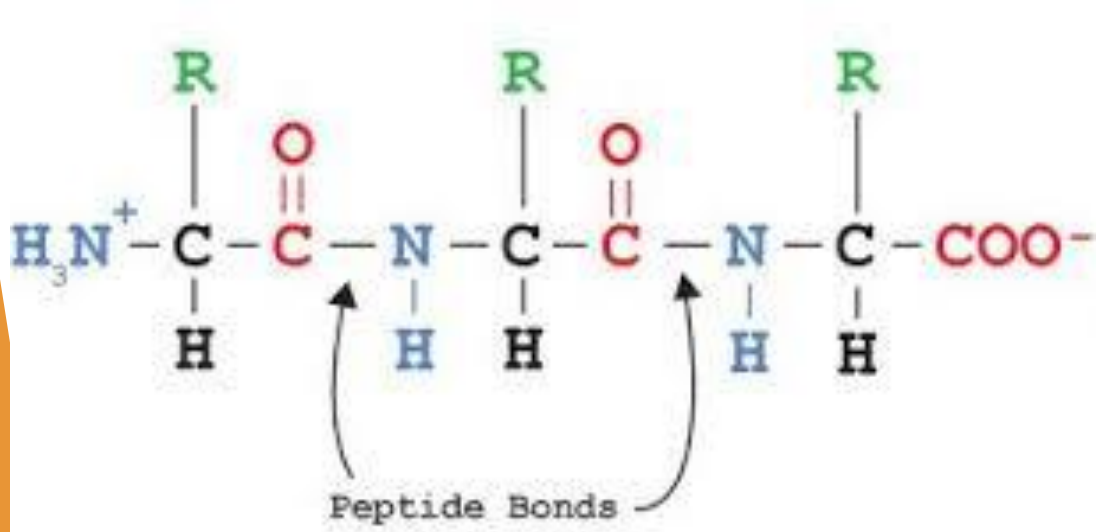
Gradbeni nivoji beljakovin

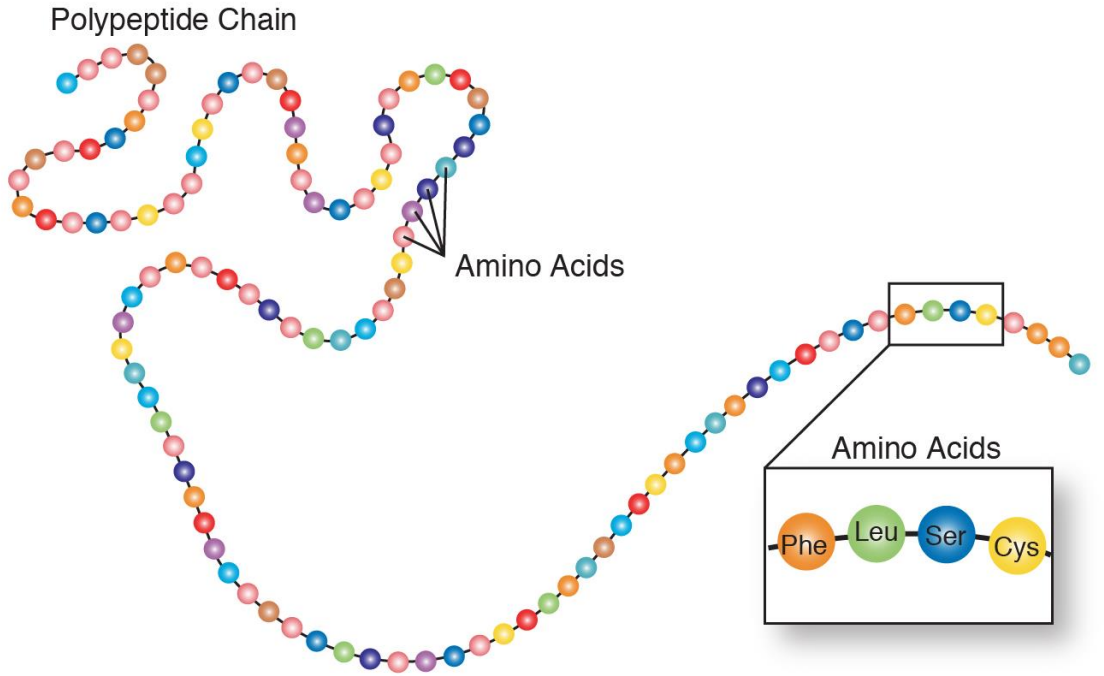
- Primarna struktura
- Sekundarna struktura
- Terciarna struktura
- Kvartarna struktura



Primarna struktura beljakovin

- AK zaporedje
- Tvorba polipeptidne verige



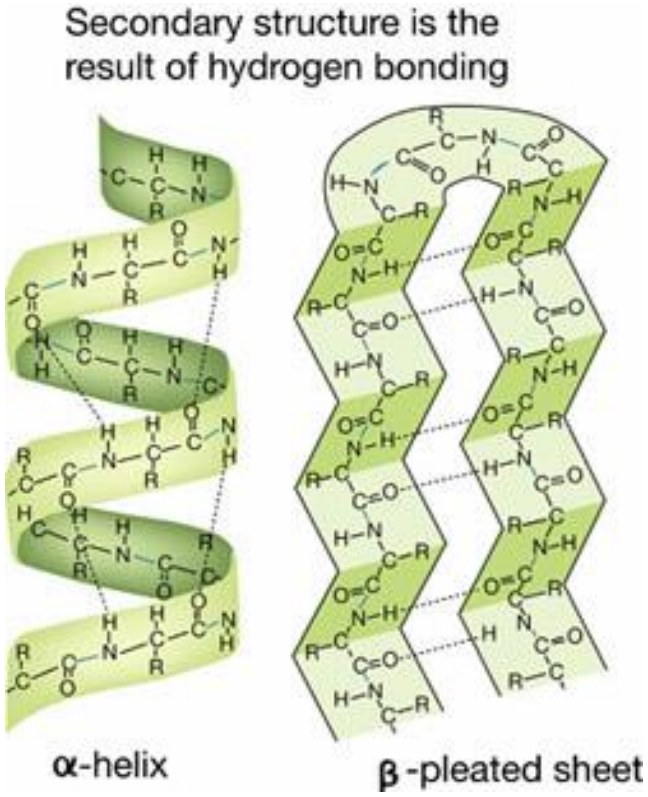


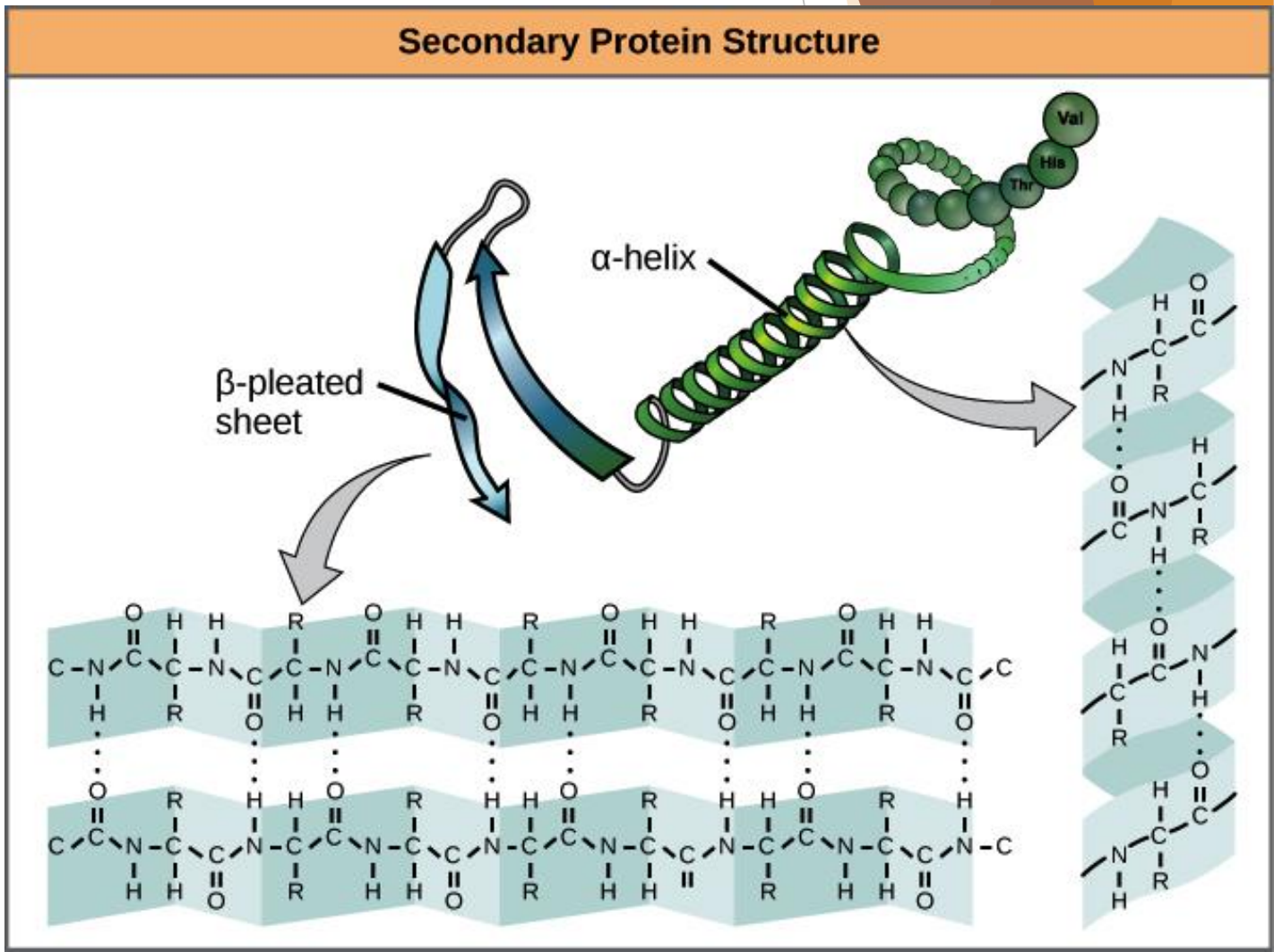
Amino Acids

Ala: Alanine	Gln: Glutamine	Leu: Leucine	Ser: Serine
Arg: Arginine	Glu: Glutamic acid	Lys: Lysine	Thr: Threonine
Asn: Asparagine	Gly: Glycine	Met: Methionine	Trp: Tryptophane
Asp:Aspartic acid	His: Histidine	Phe: Phenylalanine	Tyr: Tyrosisne
Cys:Cysteine	Ile: Isoleucine	Pro: Proline	Val: Valine

Sekundarna struktura proteina

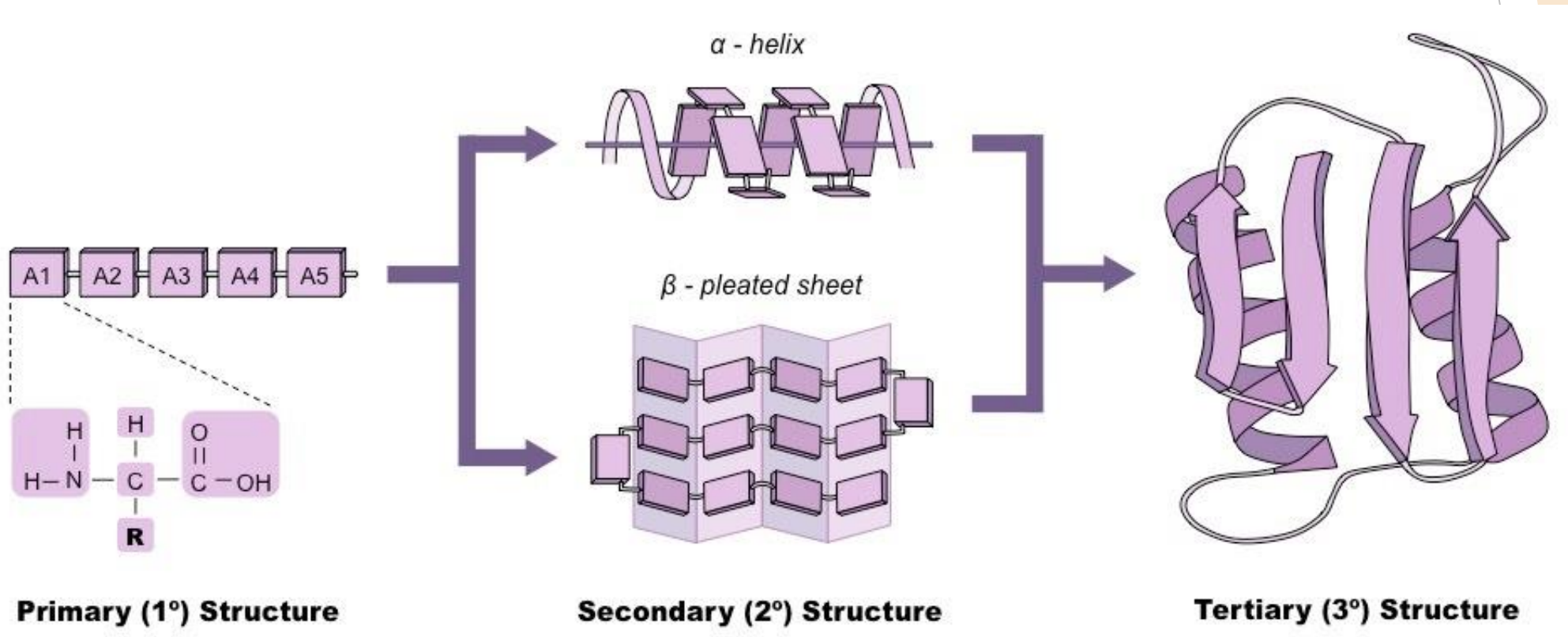
- Zvijanje in gubanje polipeptidnih verig
- Alfa vijačnica
- Beta ploskev



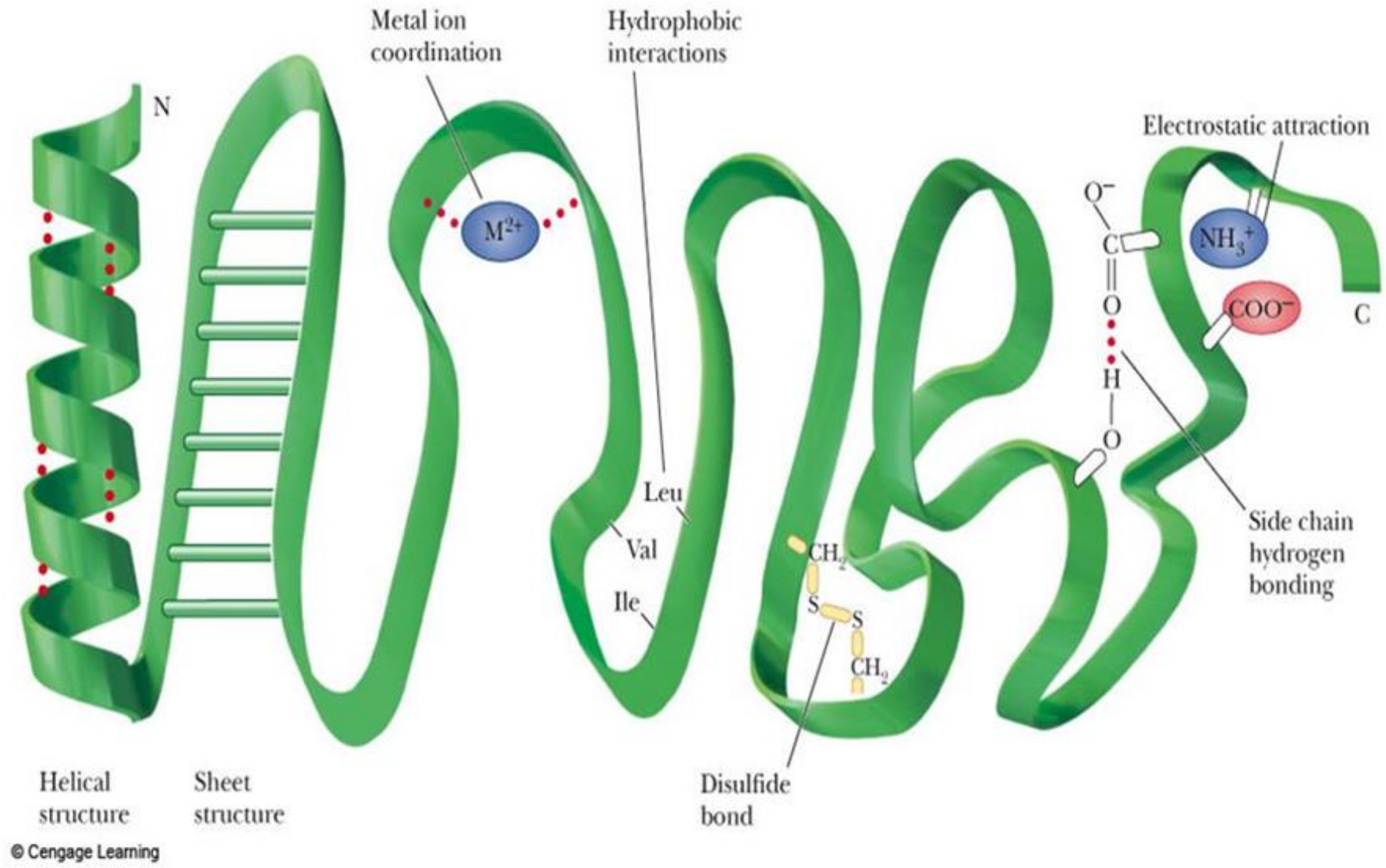


Terciarna struktura proteina

- Interakcija med sekundarnimi strukturami
- Oblikovanje strukture terc. zgradbe na račun radikalov aminokislin s posebnimi lastnostmi
- Vodikove, ionske, kovalentne vezi

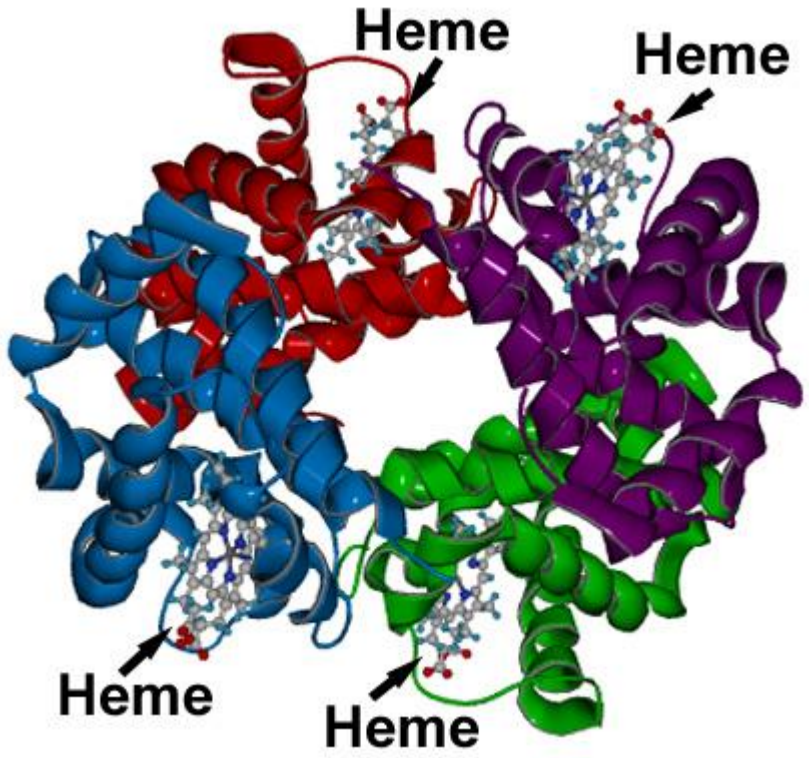


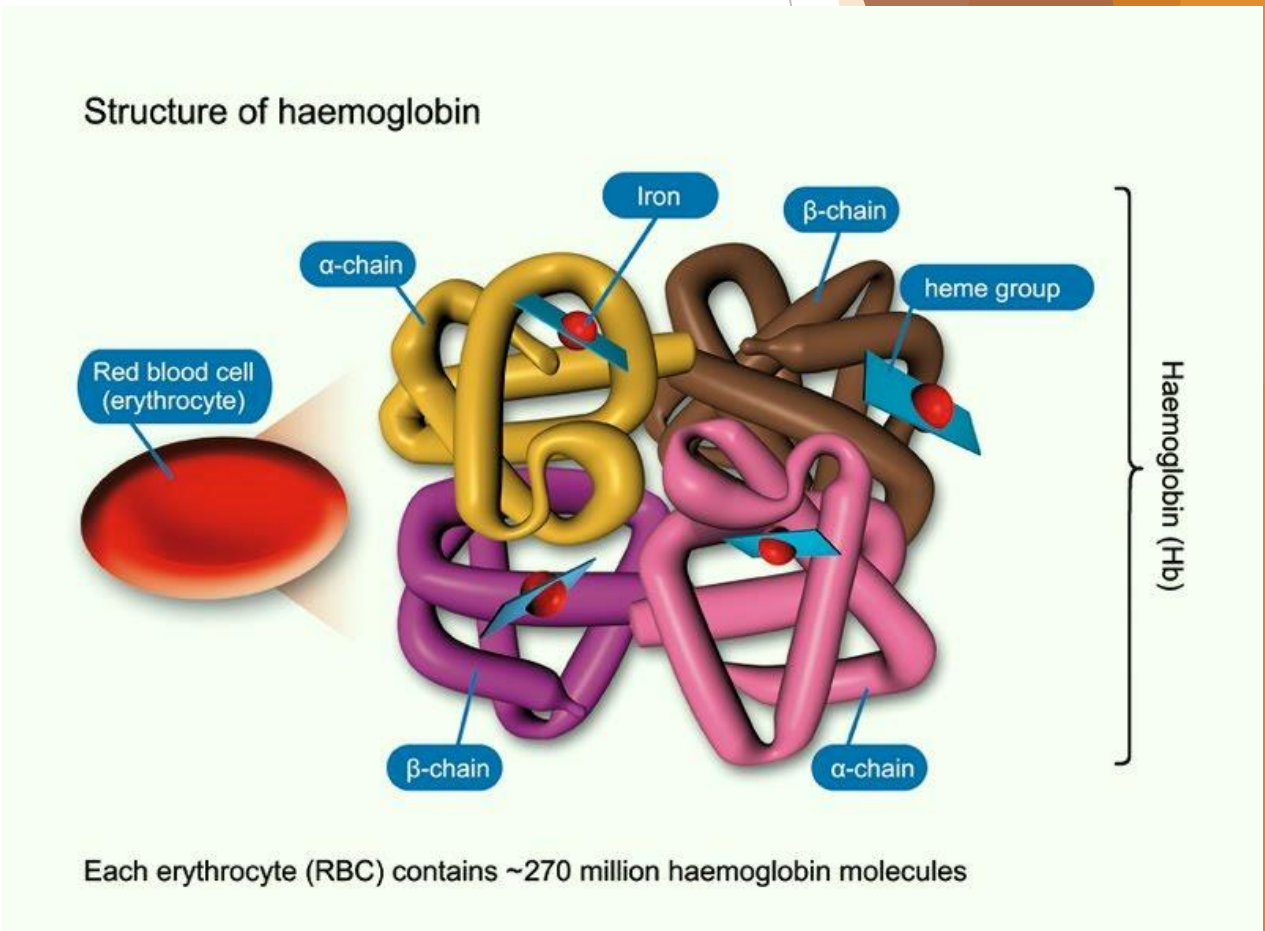
Forces That Stabilize Protein Structure

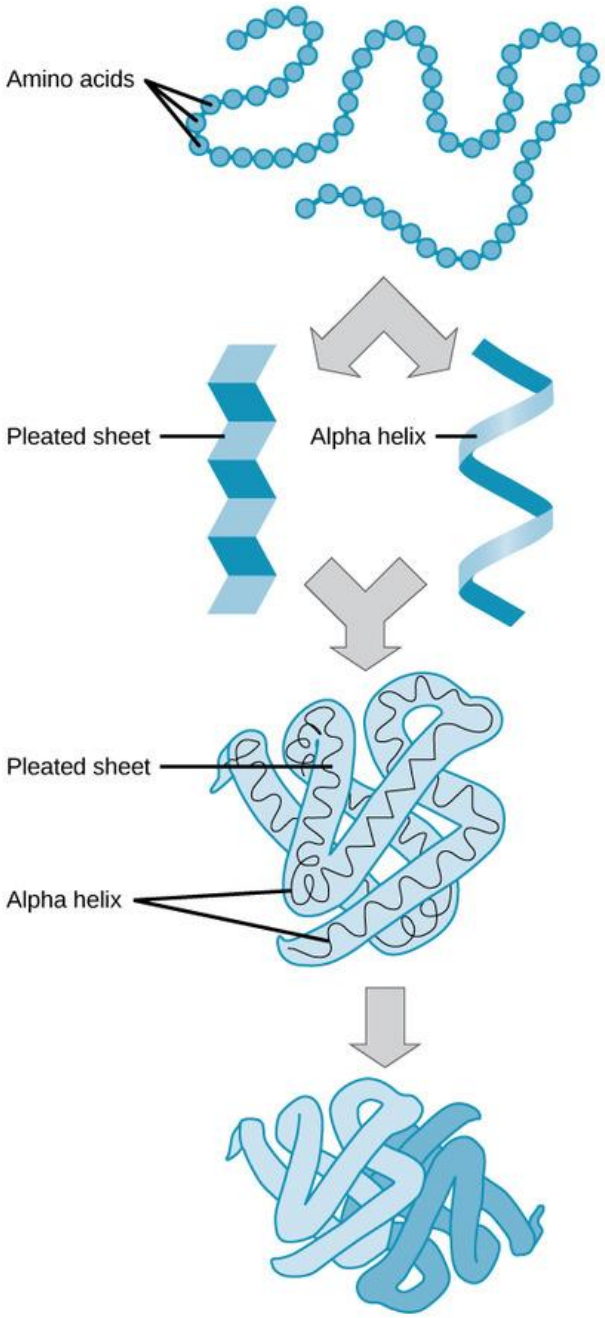


Kvartarna struktura proteina

- Povezovanje več polipeptidnih verig







Primary Protein structure
sequence of a chain of animo acids

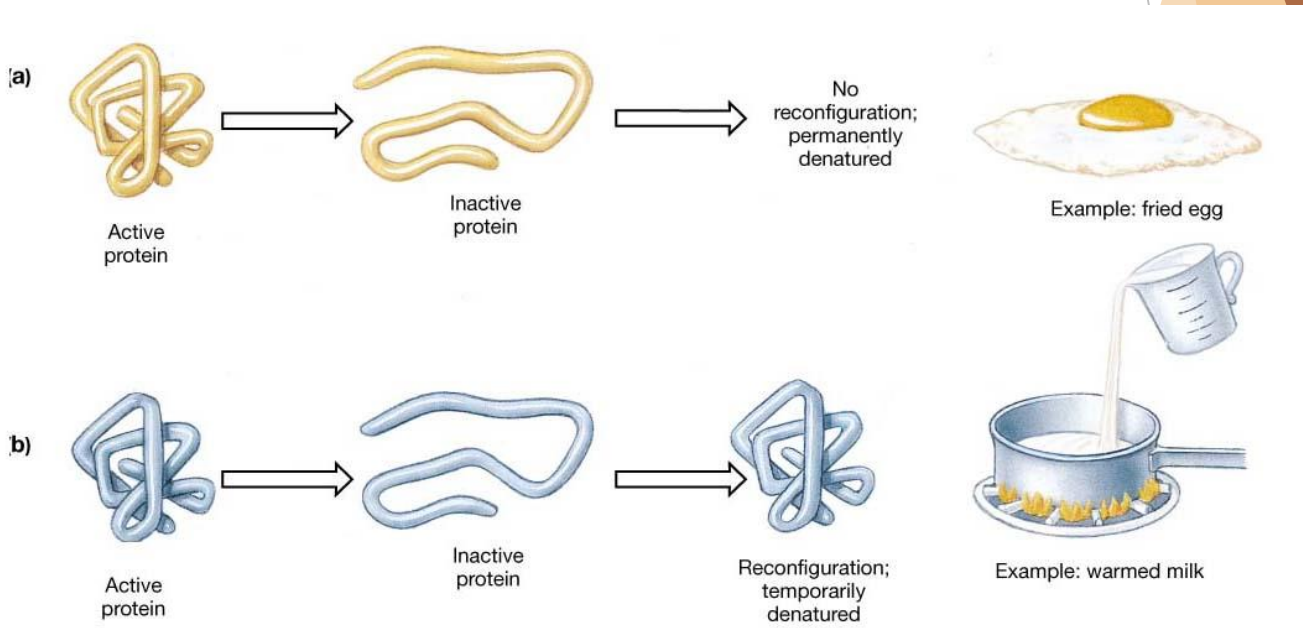
Secondary Protein structure
hydrogen bonding of the peptide backbone causes the amino acids to fold into a repeating pattern

Tertiary protein structure
three-dimensional folding pattern of a protein due to side chain interactions

Quaternary protein structure
protein consisting of more than one amino acid chain

Značilnosti beljakovin

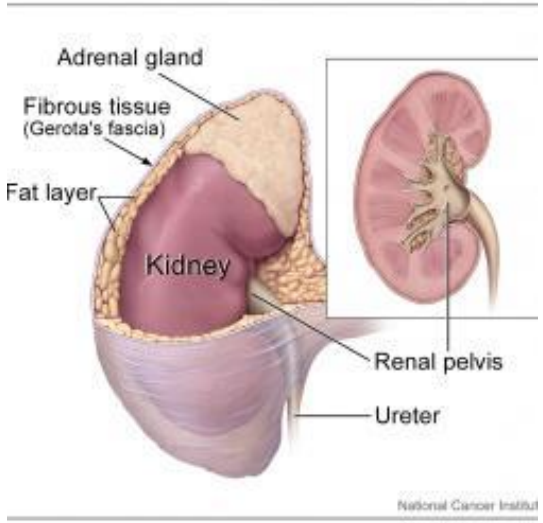
- Struktura je odvisna od FI-KE dejavnikov
- T, pH, konc. Soli
- Neustrezni pogoji → prekinitev vezi in porušenje 3D strukture proteina
- DENATURACIJA
- Reverzibilna denaturacija - renaturacija
- Ireverzibilna denaturacija



LIPIDI

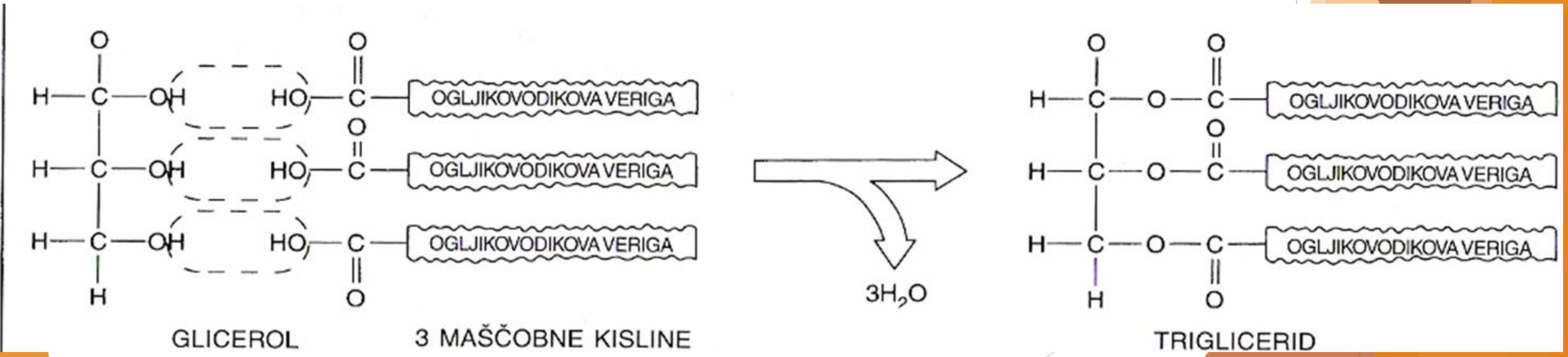
- Pomembna zaloga E
- Osnovni gradniki biotskih membran
- Toplotni izolator
- Mehanska zaščita
- Hidrofobna narava
- Niso polimeri in običajno manjše molekule
- Biološko pomembni lipidi:

- Maščobe
- Fosfolipidi
- Steroidi
- Voski



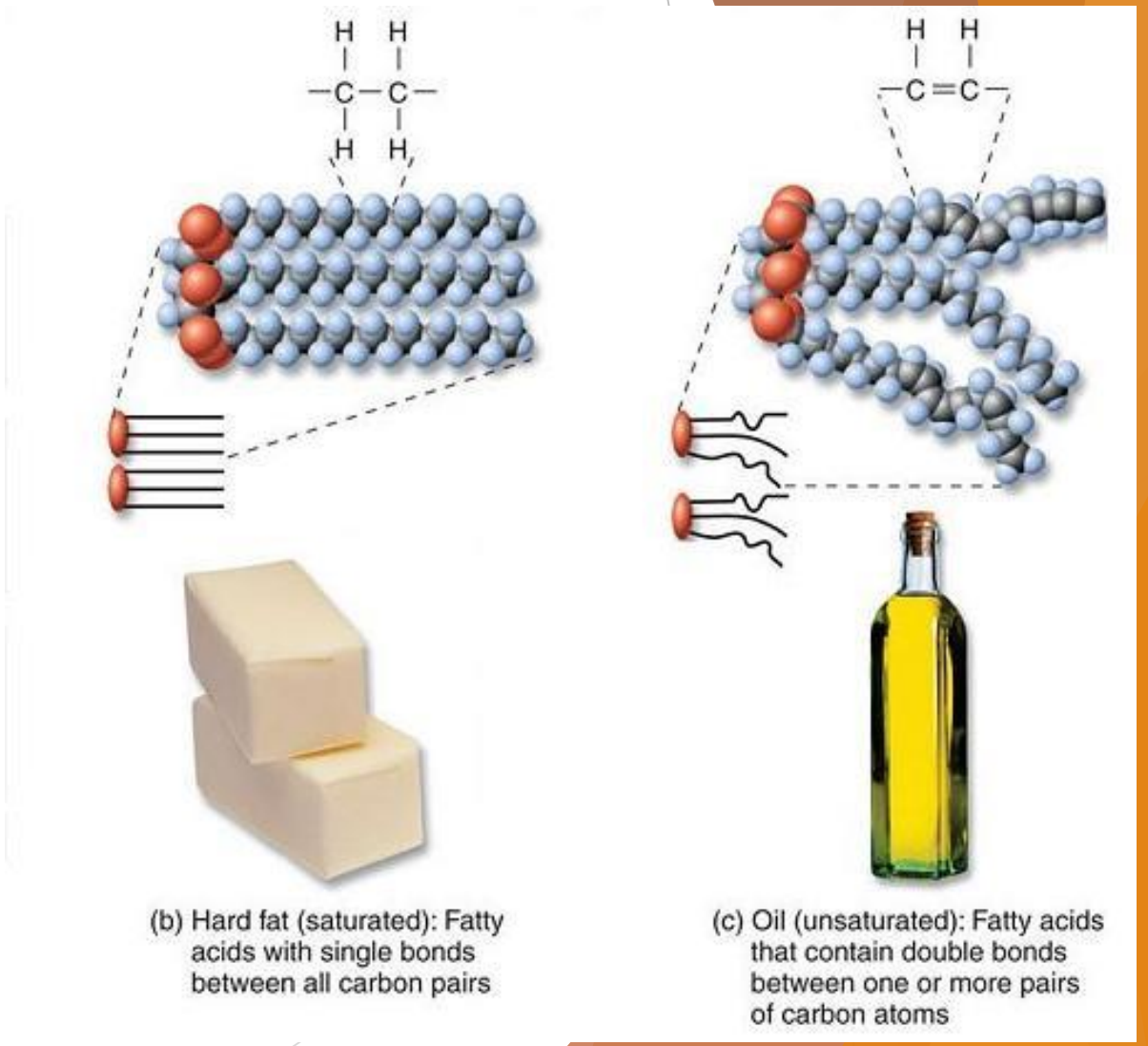
Maščobe

- Estri glicerola in maščobnih kislin
- Glicerol (alkohol s tremi OH skupinami)
- Maščobna kislina → dolg C skelet + karboksilna skupina (-COOH)
- TRIGLICERIDI → 3 maščobne kisline + glicerol



Delitev maščobnih kislin

- Nasičene
  - Enojne vezi
  - Trdne pri sobni T
  - Živalski izvor (večina)
  - Pretvorba v holesterol
- Nenasičene
  - Najmanj ena dvojna vez
  - Tekoče pri sobni T
  - Rastlinski izvor



(b) Hard fat (saturated): Fatty acids with single bonds between all carbon pairs

(c) Oil (unsaturated): Fatty acids that contain double bonds between one or more pairs of carbon atoms

Nasičene maščobe

- Maslo
- Mast
- Kokosovo olje

Nenasičene maščobe

- Rastlinska olja (sončnično, repično, olivno olje,..)
- Oreščki
- Ribje olje

FATS

✗ Trans Fats

- Hydrogenated vegetable oils
- Fast foods
- Cakes/pastries
- Chocolate
- Deep Fried Food

✗ Saturated Fats

Vegetable Fats

- Coconut
- Palm oil
- 3-in-1 & 2-in-1 beverages, creamer, condensed milk

Animal Fats

- Poultry skin
- Fatty meat
- Butter
- Ghee
- Tallow / lard
- Full cream dairy products

✓ Unsaturated Fats

Polyunsaturated

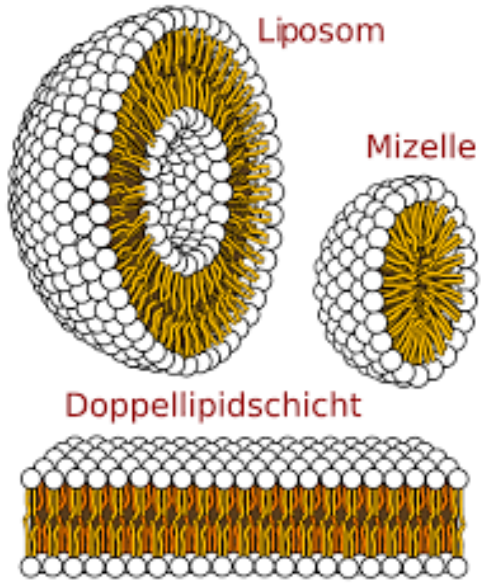
- Corn oil
- Soybean oil
- Sunflower oil
- Seeds
- Cold-water fish

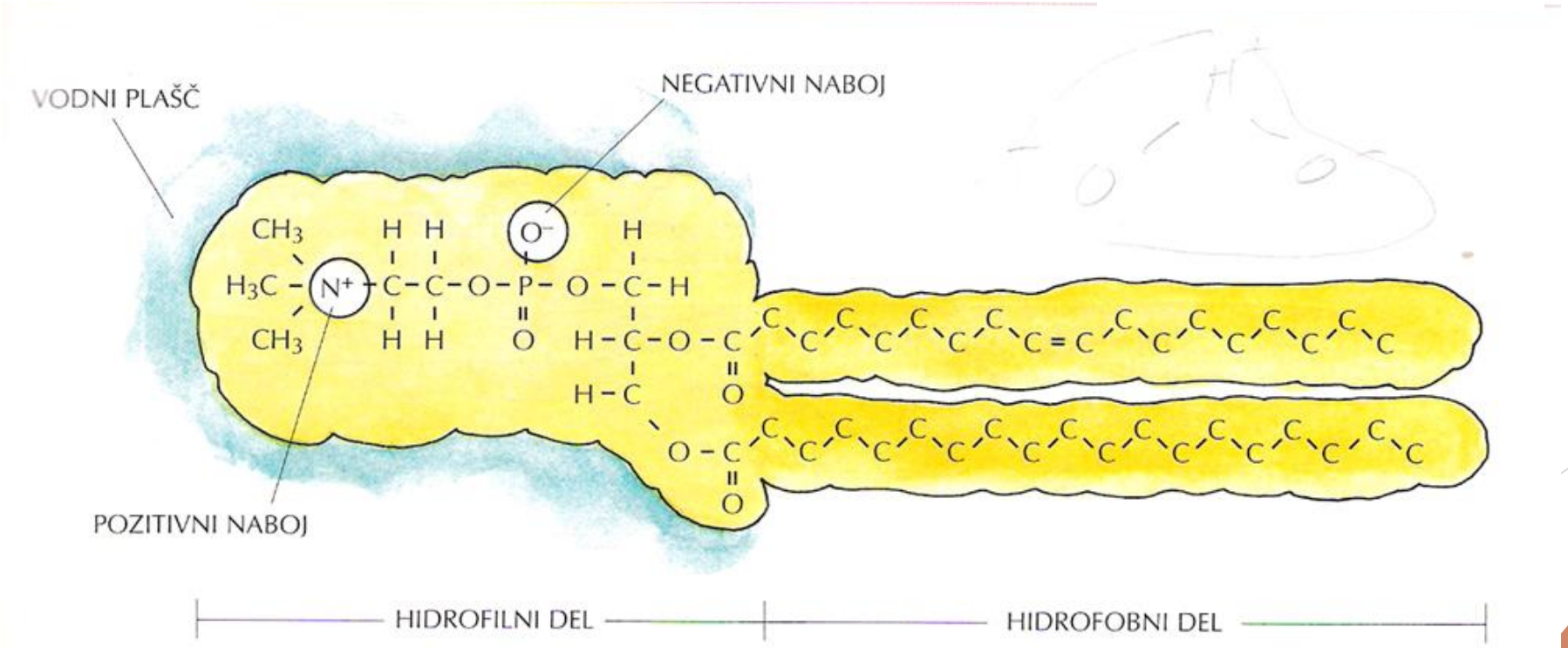
Monounsaturated

- Olive oil
- Canola oil
- Peanut oil
- Sesame oil
- Avocado
- Most nuts

Fosfolipidi

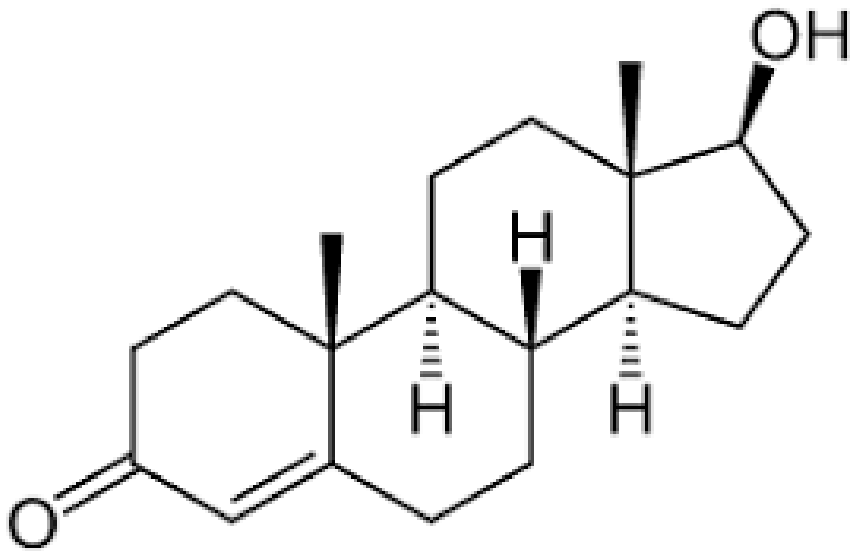
- Osnovni gradnik biotskih membran
- Glicerol + 2 maščobni kislini +fosfat
- LIPOSOM

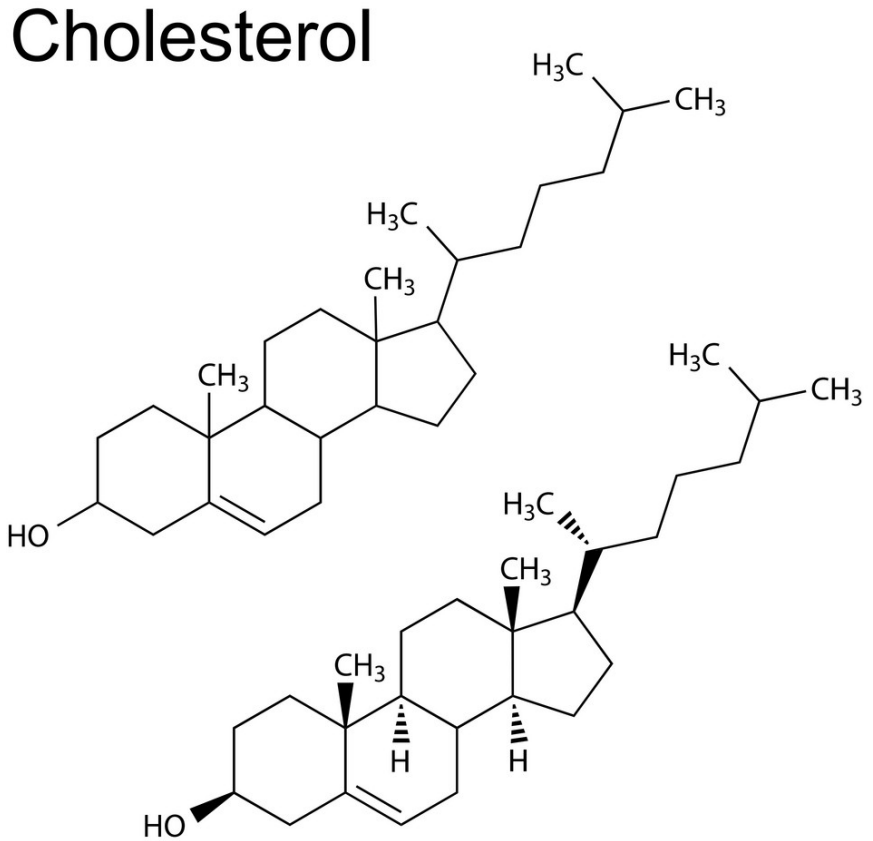




Steroidi

- Skelet iz 4 C obročev + skupina, ki določa vlogo steroida v celici
- Holesterol



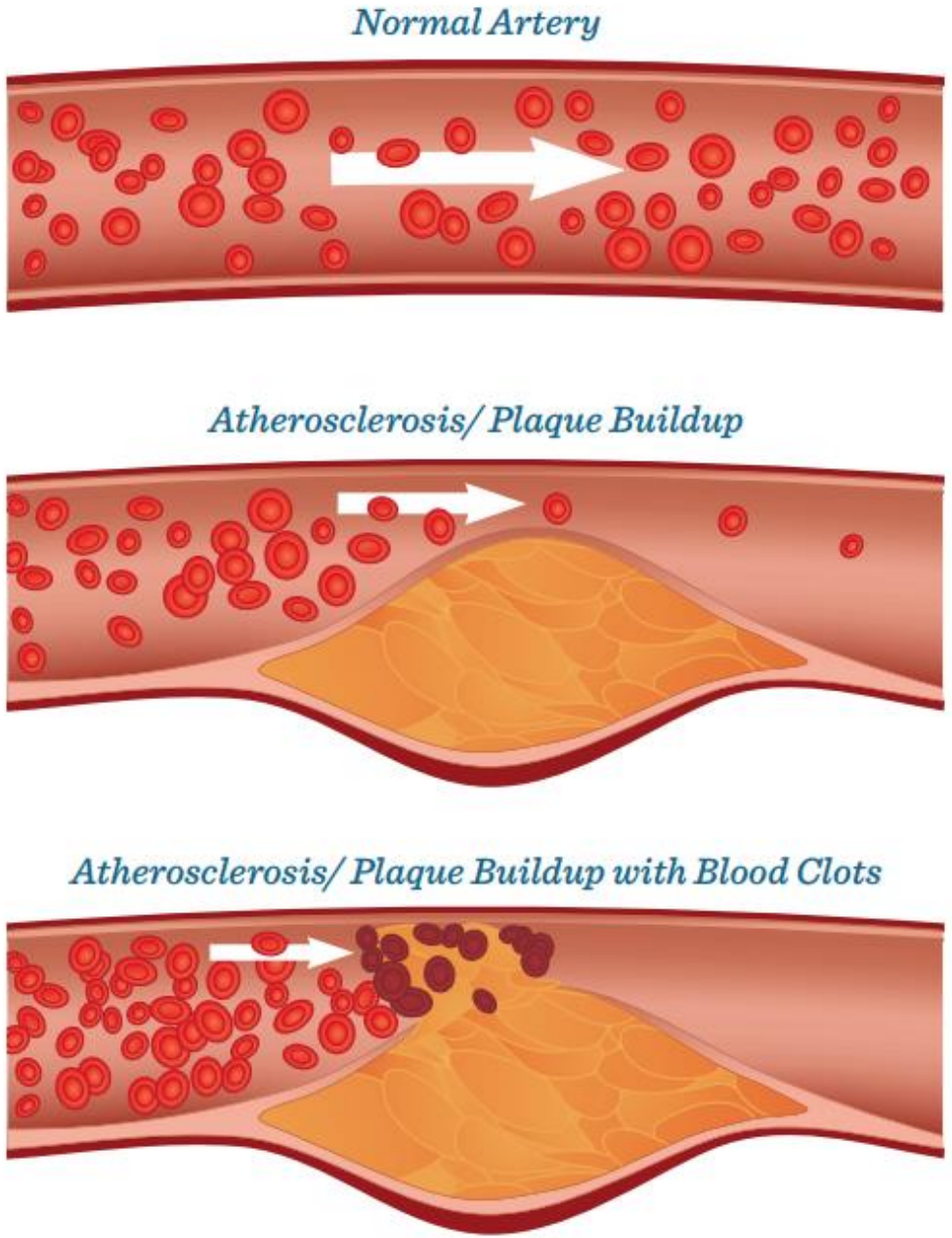


LDL - HDL

- Prenos holesterola po krvi v obliki lipoproteinov
- LDL → low density lipoproteins (malo beljakovin, veliko holesterola → „slab“

- ateroskleroza

- HDL → high density lipoproteins (veliko beljakovin, malo holesterola → „dober“



Anabolni steroidi

- Doping
- Nedovoljene snovi umetnega izvora → povečana telesna sposobnost
- Derivati testosterona
- Povečanje mišične mase
- Stranski učinki