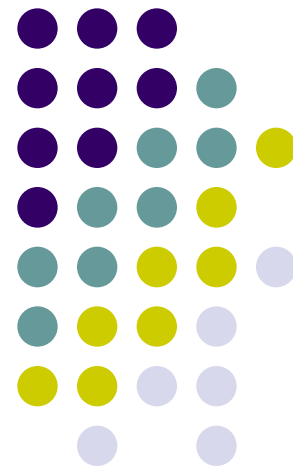




Tsütoloogia

2020

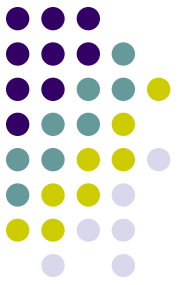


Rakk (*cellula, cytus*)



- On organismi põhiline struktuurne ja funktsionaalne ühik, millel on olemas kõik elu iseloomustavad tunnused: **ainevahetus, liikuvus, erutuvus ja paljunemine.**
- Sarnase ehituse ja talitlusega rakud koos nende poolt produtseeritud rakuvaheainega moodustavad kudesid
- Koed moodustavad elundeid
- Elund on organismi osa, millel on kindel kuju, ehitus ja asetus ja ta täidab temale omast funktsiooni
- Elundsüsteem koosneb ehituse, talitluse ja arenemise poolest sarnastest elunditest

Rakk

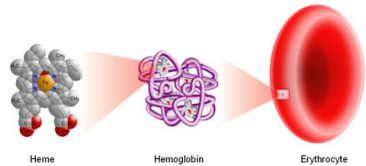
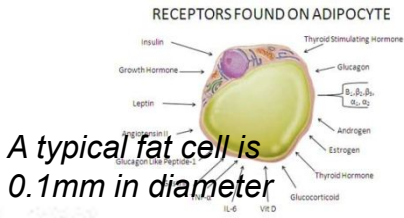


- Kujult võivad rakud olla lamedad, kuubikujulised, käävjad, jätketega varustatud
- Vaatamata rakkude suurele erinevusele kuju ja suurusele poolest on **raku ehituse põhistruktuur ühesugune**: põhilisteks osadeks on tuum ja tsütoplasma koos organellidega, mis on ümbritsetud plasmamembraani poolt.



Raku suurus ja kuju sõltub koeliigist, asukohast selles ning raku elu- ja töötsüklist

125-150µm (10mm); 60µm;



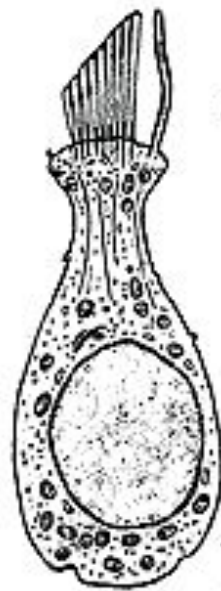
St
7,5 µm

10-15cm;



M

50µm;



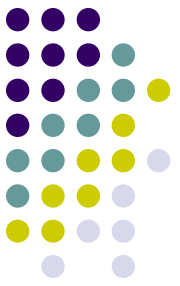
Hair cell



120 µm

N

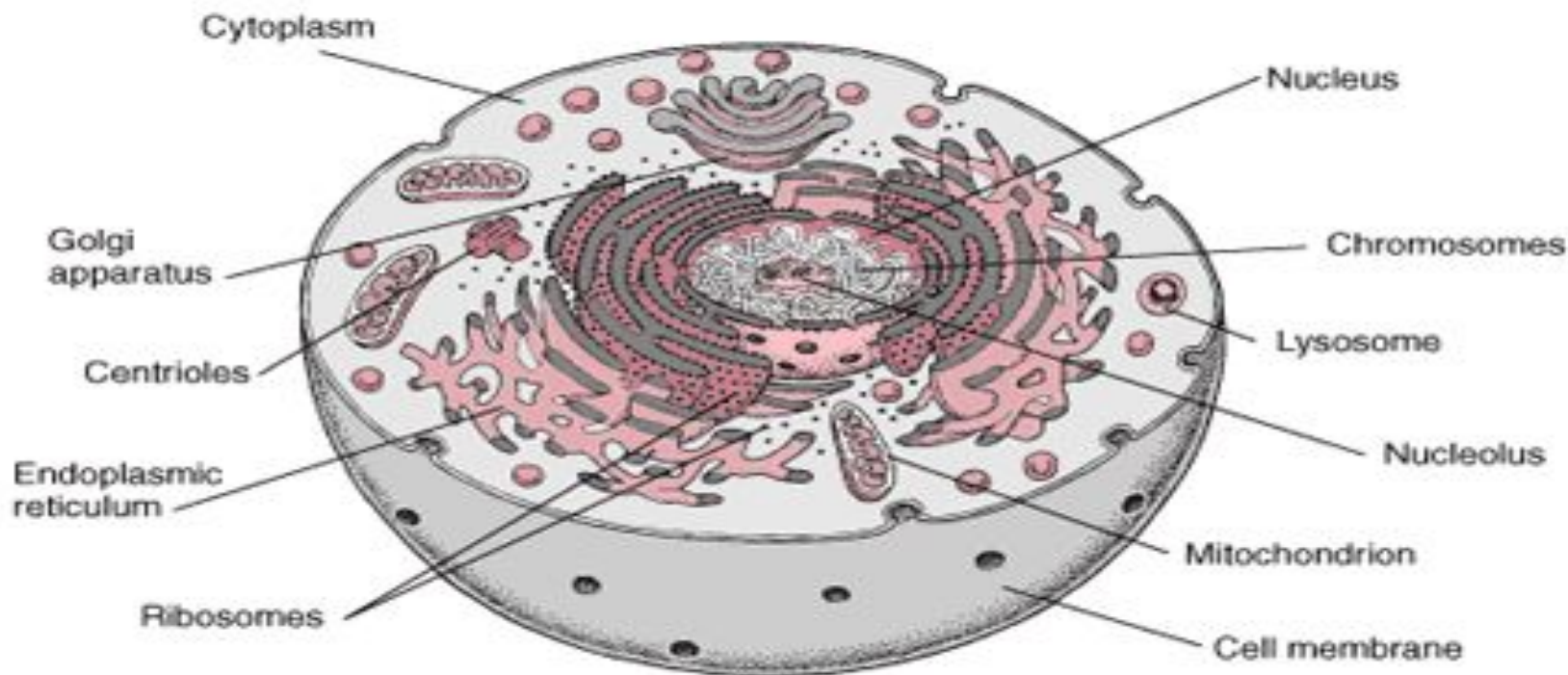
Raku ehitus



- 1. Plasmamembraan, mis ümbritseb väljastpoolt rakku
- 2. Tsütoplasma, mis koosneb läbipaistvast põhitsütoplastmast (vesilahus, mis sisaldab vees lahustunud elektrolüüte, metaboliite, RNA, sünteesitud proteiine)
- 3. organellid ja/või inklusioonid
- 4. Rakutuum

contains chromosomes, which are the cell's genetic material, and a nucleolus, which produces ribosomes. The cytoplasm consists of a fluid material and organelles, which could be

for the cell's activities. Lysosomes contain enzymes that can break down particles entering the cell. Centrioles participate in cell division.



Examples of Different Cells

Epithelial Cell



Muscle Cell



Nerve Cell

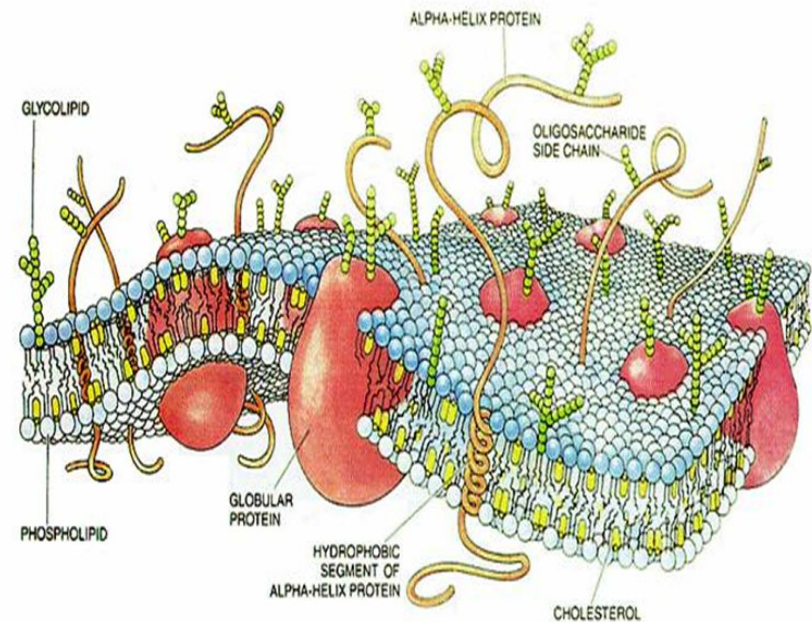


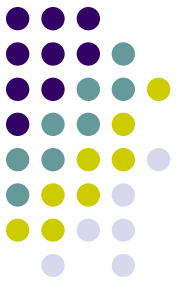
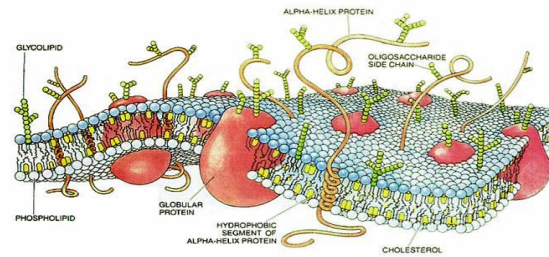
Connective Tissue Cell



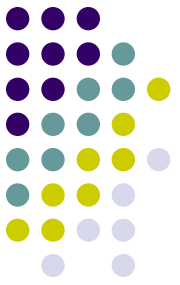
Plasmamembraan

- 8 -10 nm paksune kest
- Koosneb:
 1. kahest lipiidikihist
 2. integraalsetest valkudest, mis talitlevad transportkanalitena või retseptoorsete valkudena
 3. Perifeerse proteiini molekulidest, mis paiknevad membraani sise - või välispinnal
 4. Glükokaalüksitest – polüsahhariidide molekulid rakumembraani välispinnal





- Plasmamembraani vahendusel toimub aine-, energia- ja infovahetus raku ja väliskeskkonna vahel.
- Plasmamembraani lipiidkiht on barjäär enamikule molekulidele.
- Funktsioneerib retseptoritena võttes keemilisi signaale. Kontakteerudes ainult mingi kindla rakuvälises keskkonnas leiduva ainega – näit hormoonid (insuliin)
- Plasmamembraan eraldab ja hoiab lahus kahte erinevat vedelikuruumi: tsütoplasmat ja rakuvälist vedelikku.
- Transpordib molekule raku ja rakust välja

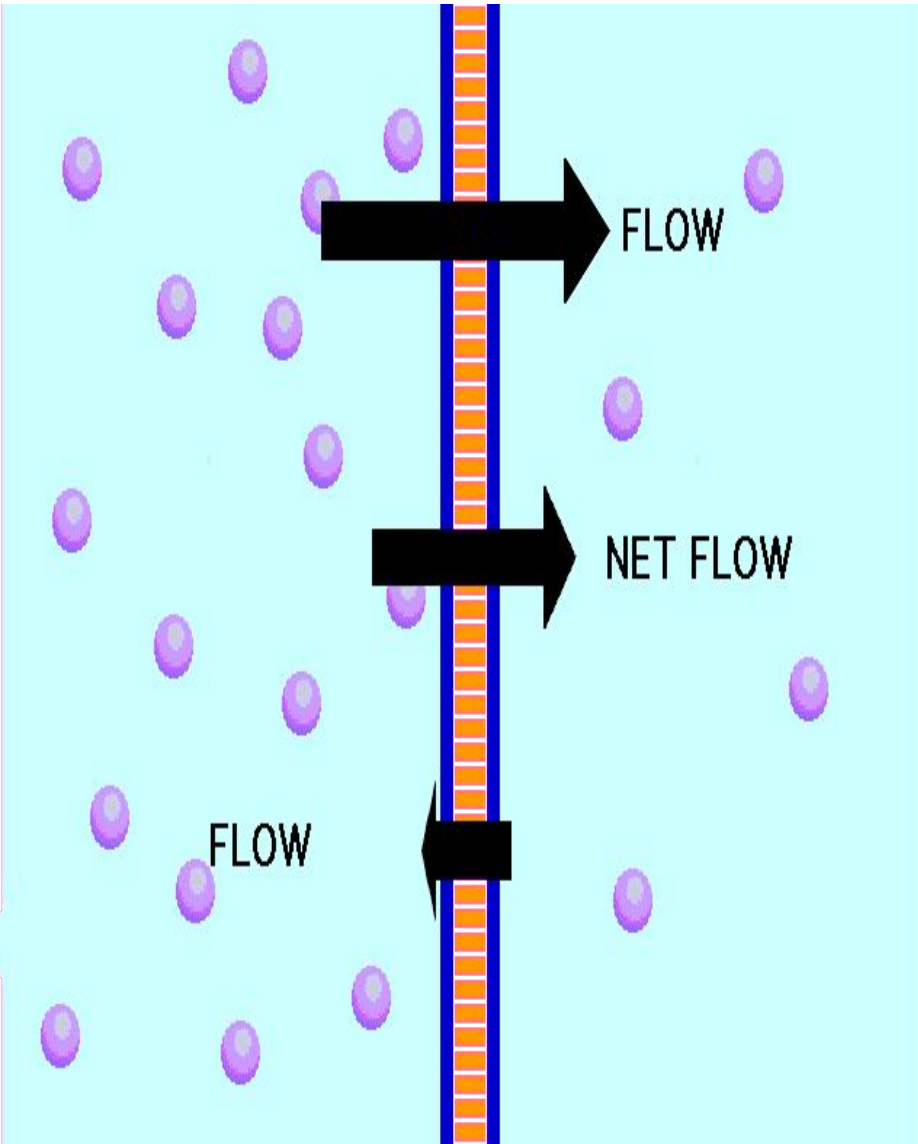
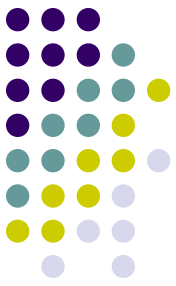


- Kuidas toimub transport läbi plasmamembraani?

Difusioonil lahustes (ja gaasides)

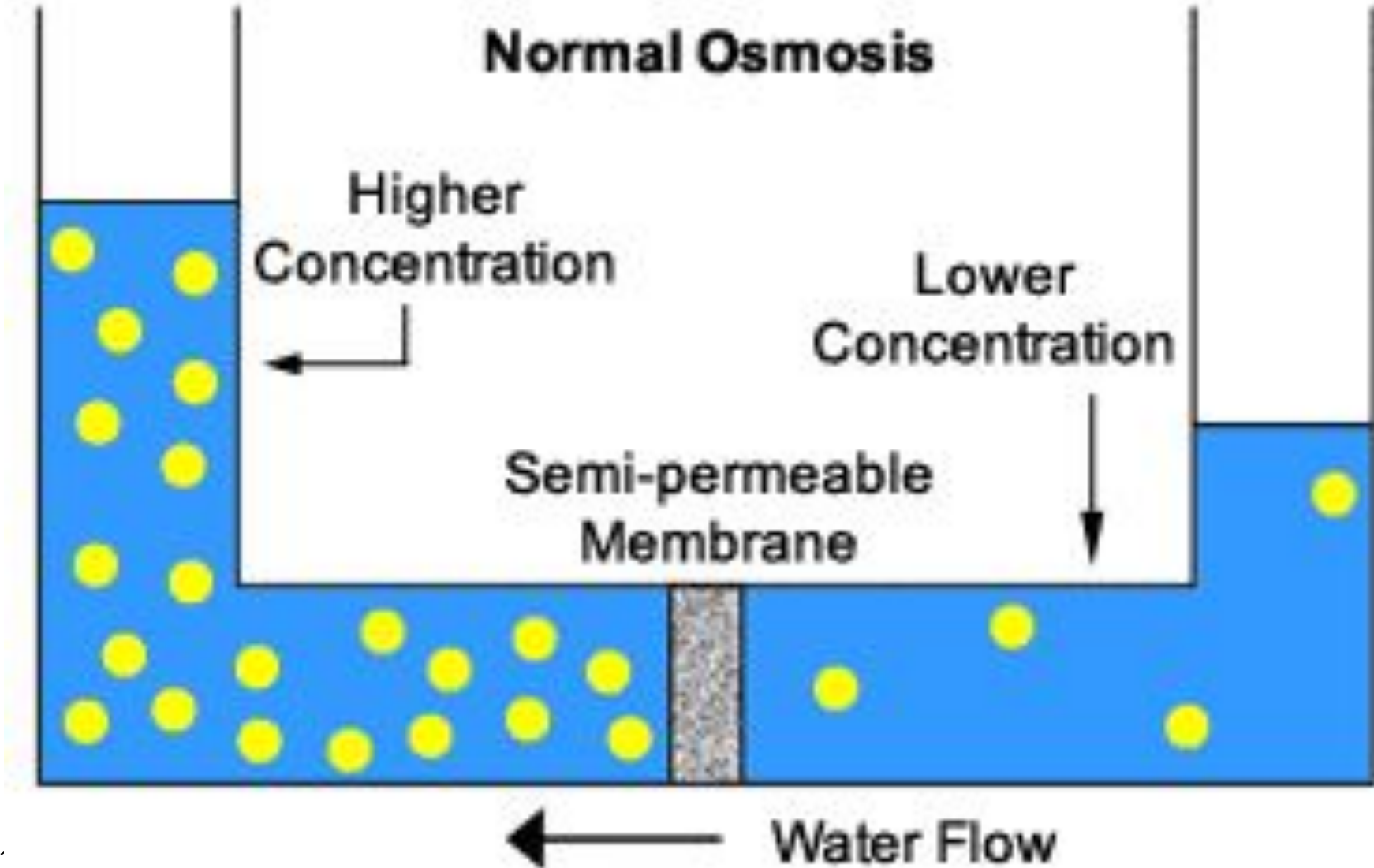
liiguvad aatomid ja molekulid

kontsentratsioonide võrdsustumiseni



- Läbi lipiidmembraani võivad vabalt difundeeruda vesi ja lahustunud gaasid (O_2 ja CO_2), rasvlahustuvad ained, väikesed polaarsed molekulid (etanool, kusiaine)

Osmosis



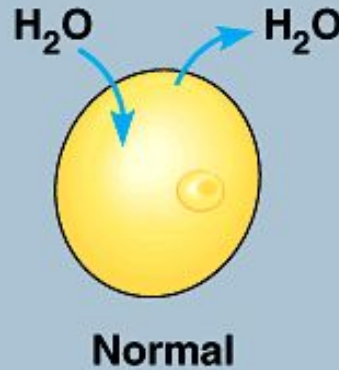
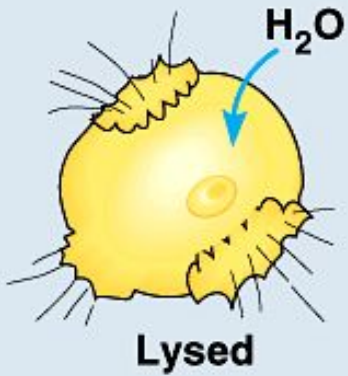
Hüpo-, iso- ja hüpertoniline lahus



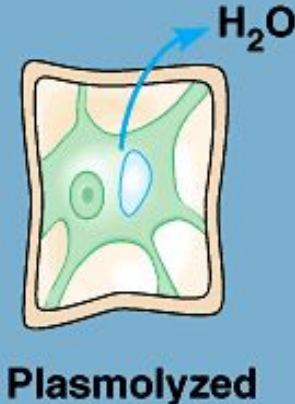
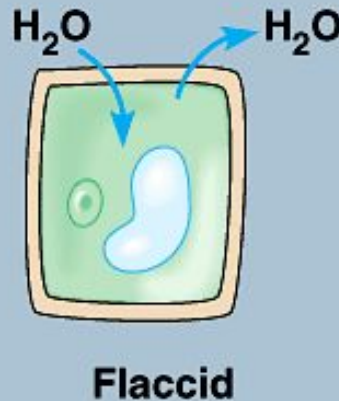
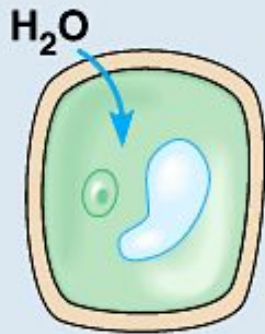
Hypotonic solution

Isotonic solution

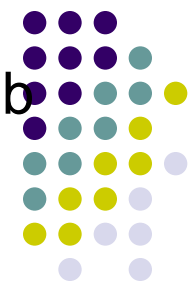
Hypertonic solution



Animal cell



Plant cell

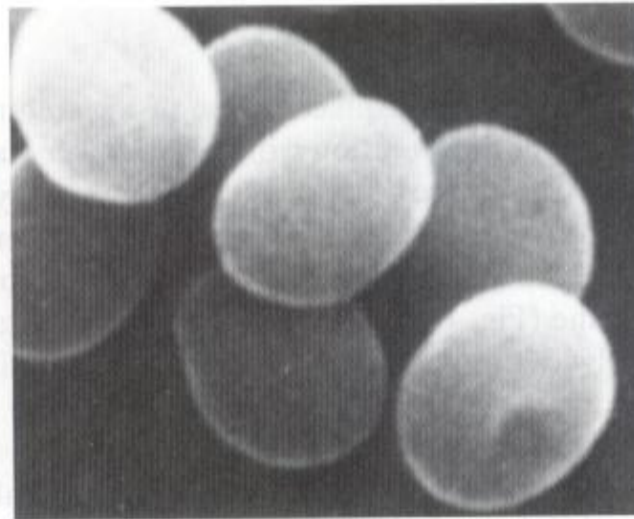


- Kolloidosmootne hemolüüs – vesi tungib rakku, see puruneb, hemoglobiin satub plasmasse

(c) Hypotonic solution



net water movement into cells

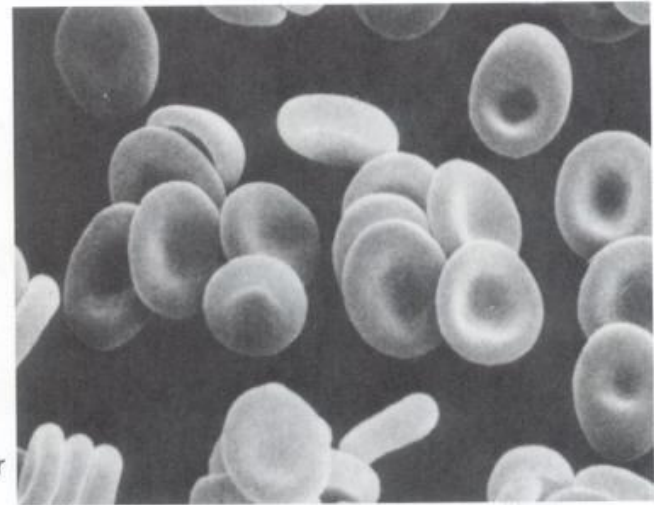


10 micrometers

isotonic solution



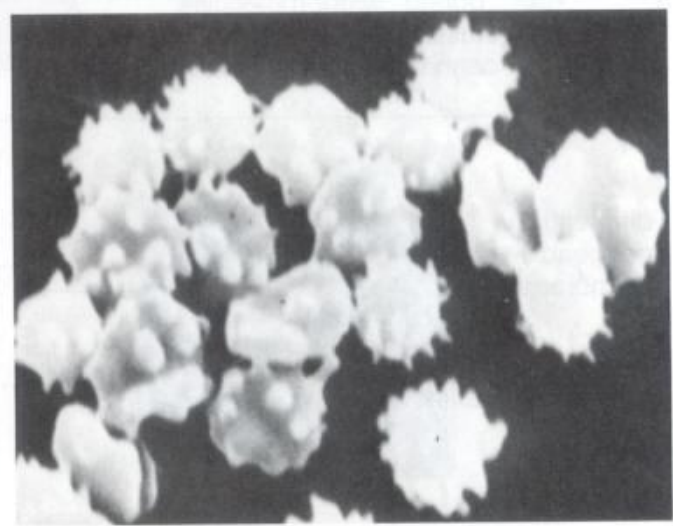
equal movement of water out of cells



(b) Hypertonic solution



net water movement out of cells

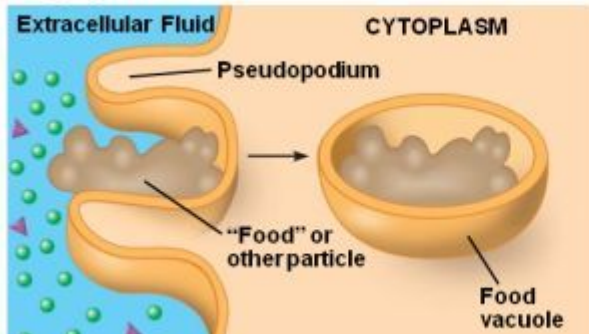


- Okasõuna kujuline erütrotsüüt, tema asetamisel hüpertoonilisse soolalahusesse

Endotsütoos

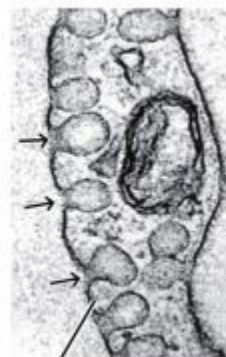
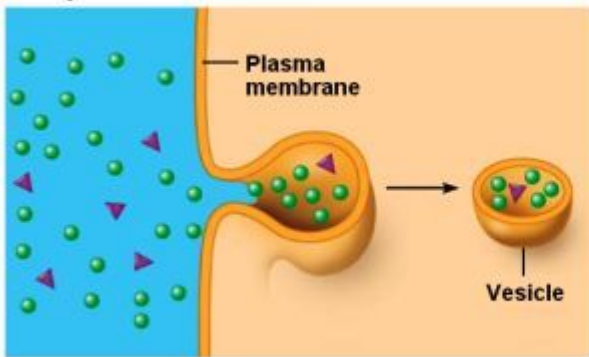


Phagocytosis



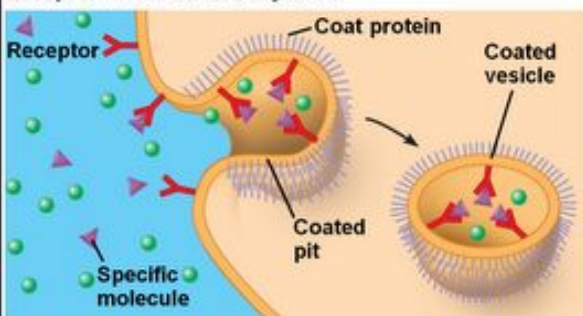
fagotsütoos – aine molekuli, bakteri rakku haaramine;

Pinocytosis

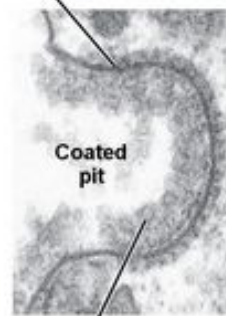


pinotsütoos – ainete siirdamine rakku membraanpõiekeste vahendusel ilma seostumiseta membraani retseptoriga

Receptor-mediated endocytosis



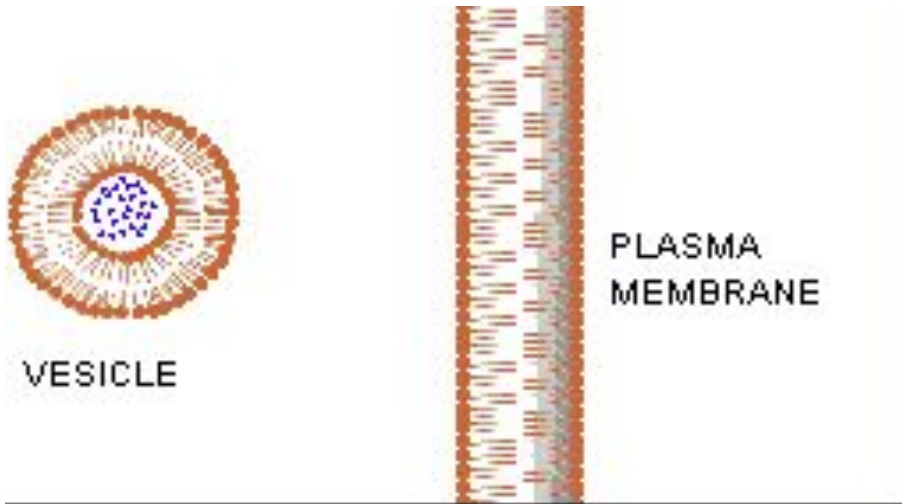
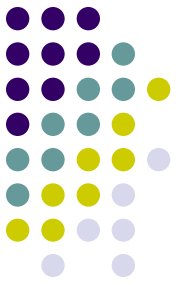
Plasma membrane



Material bound to receptor proteins

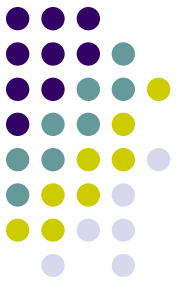
Retseptor-vahendatud endotsütoos (insuliin, kolesterool)

Eksotsütoos



Seedetrakti
limaskesta rakkude
poolt toodetud
seedeensüümide
väljutamine rakust

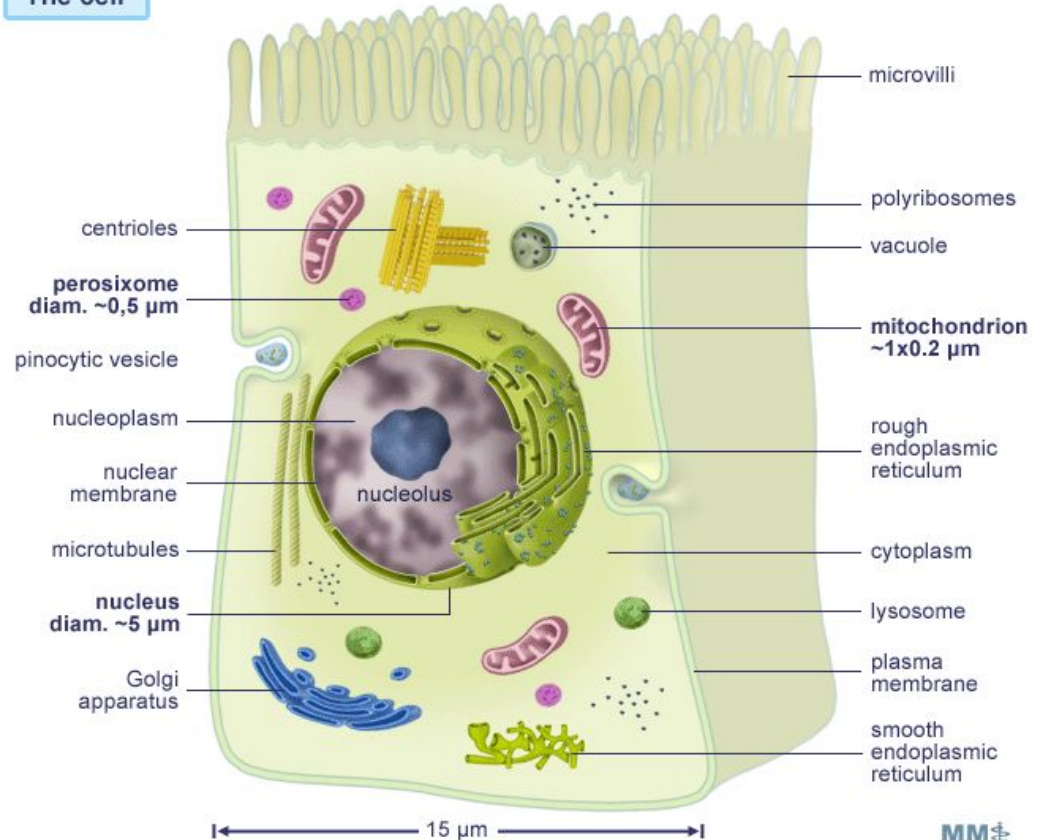
Organelid – kindlale funktsioonile spetsialiseerunud struktuurid rakus



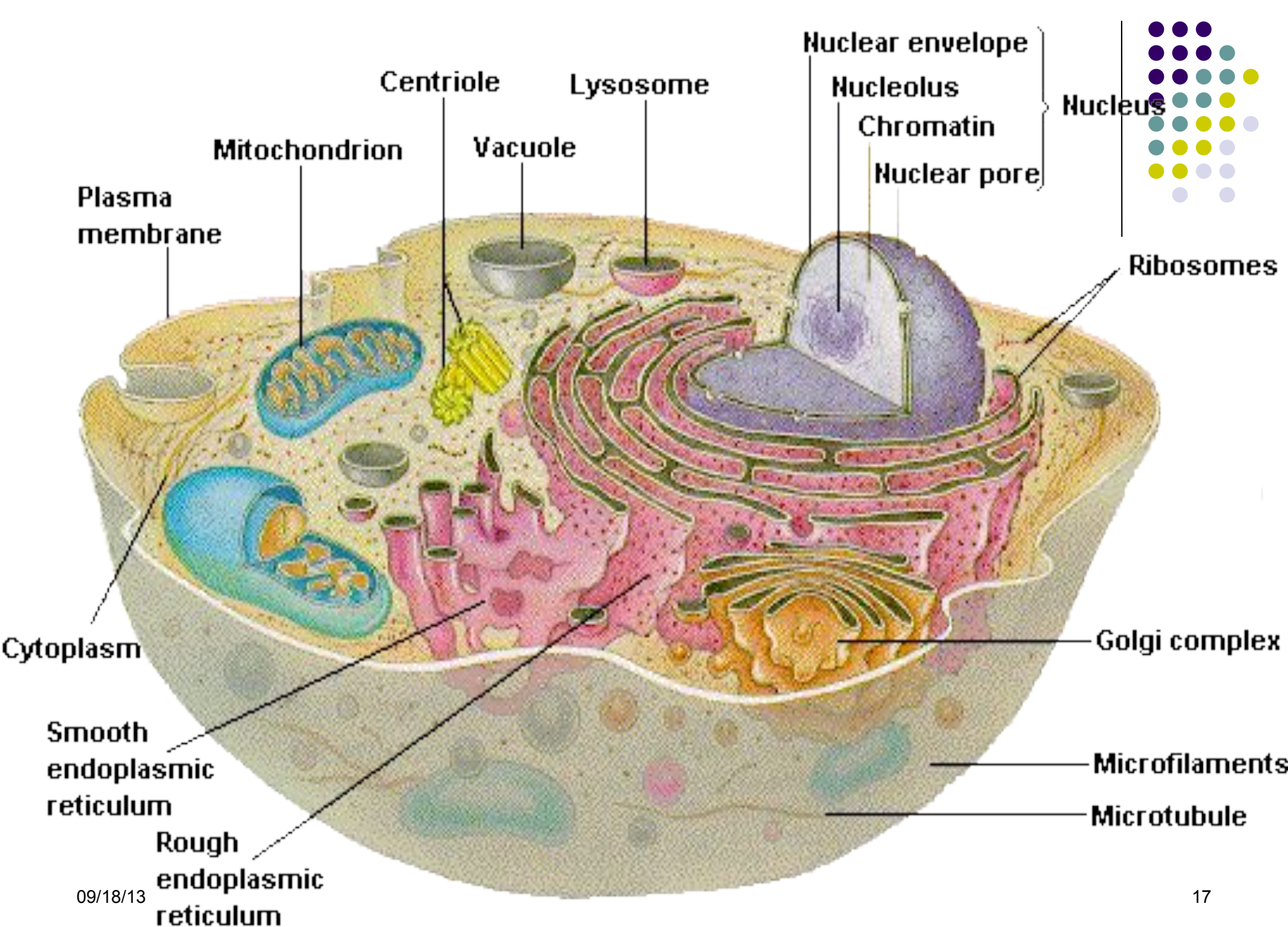
Tsütoplasma

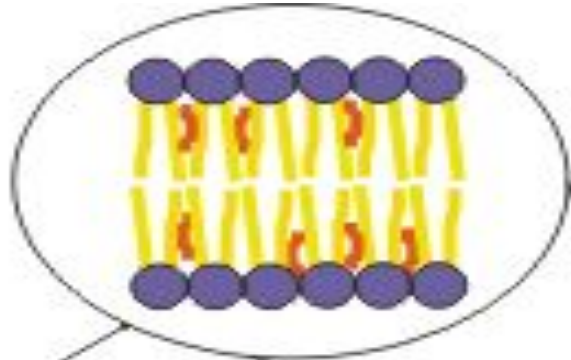
- Mitokondrid
- Ribosoomid
- Endoplasmaatiline retiikulum
- Golgi aparaat
- Lüsosoomid
- Peroksisoomid
- Tsütoskelett
- Tsentrioolid

The cell



09/18/13





Phospholipid Cell Membrane

Mitochondria

Centriole

Golgi Apparatus

Cell Membrane Proteins

Lysosomes,
Excretory vesicles,
Peroxisomes

Smooth Endoplasmic reticulum

Rough Endoplasmic Reticulum

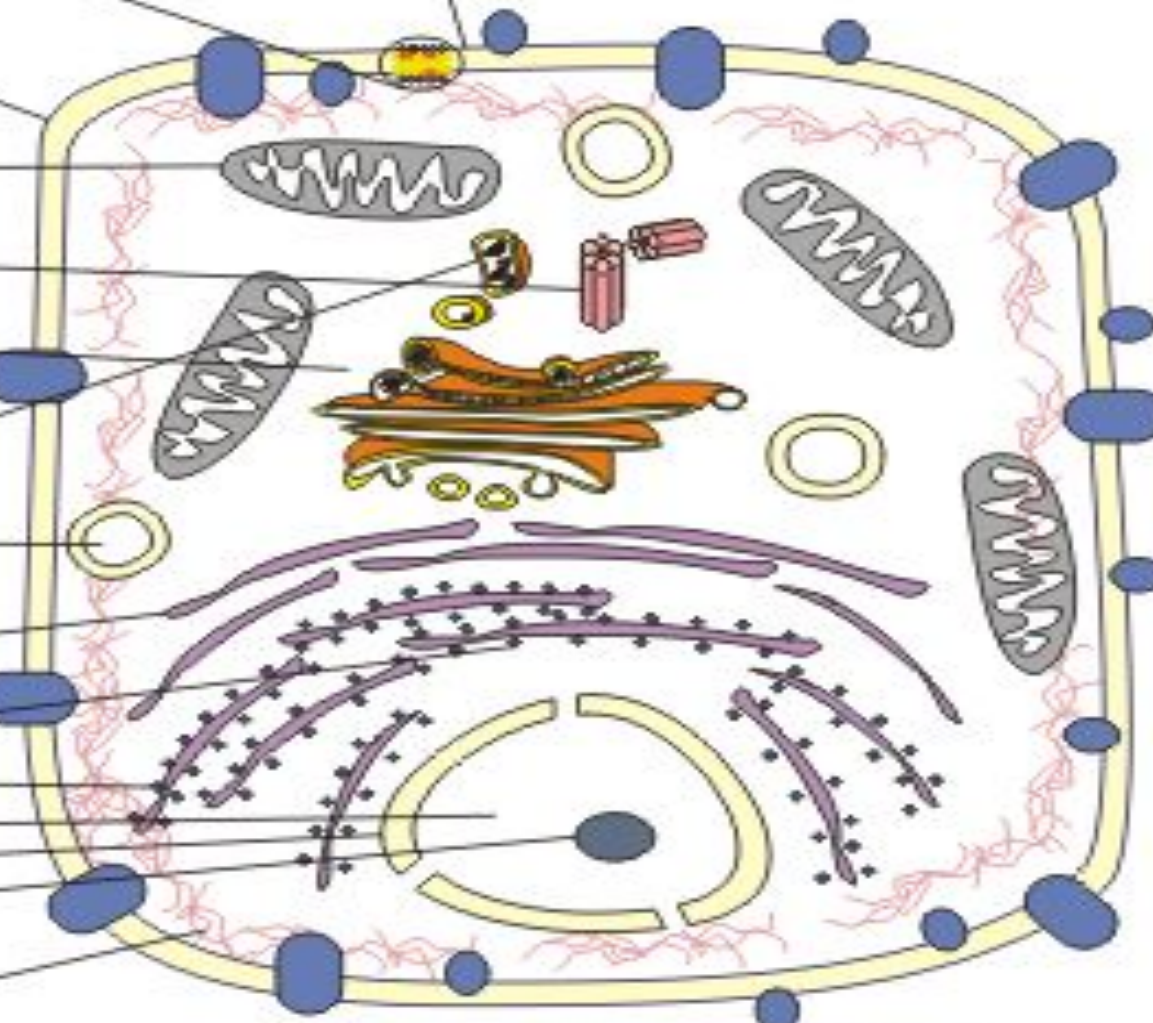
Ribosomes

Nucleus

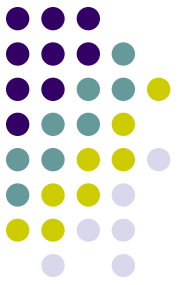
Nuclear membrane with pores

Nucleolus

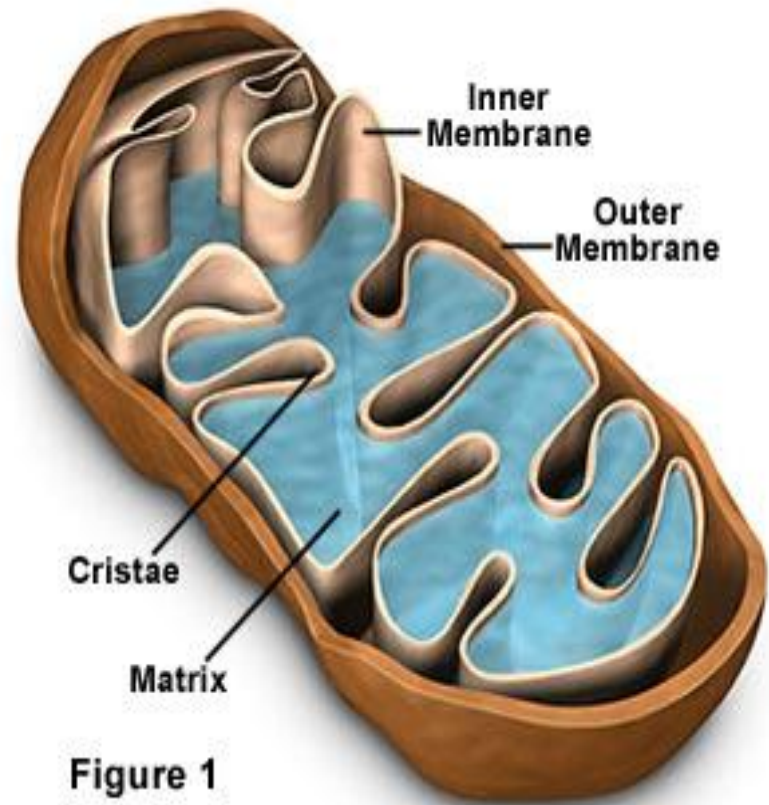
Microfilaments & Microtubules



Mitokondrid

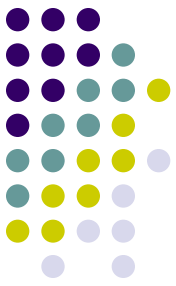


Mitochondria Inner Structure



Ribosoomid

Ribosoom koosneb
kahest allüksusest



Ribosome Structure

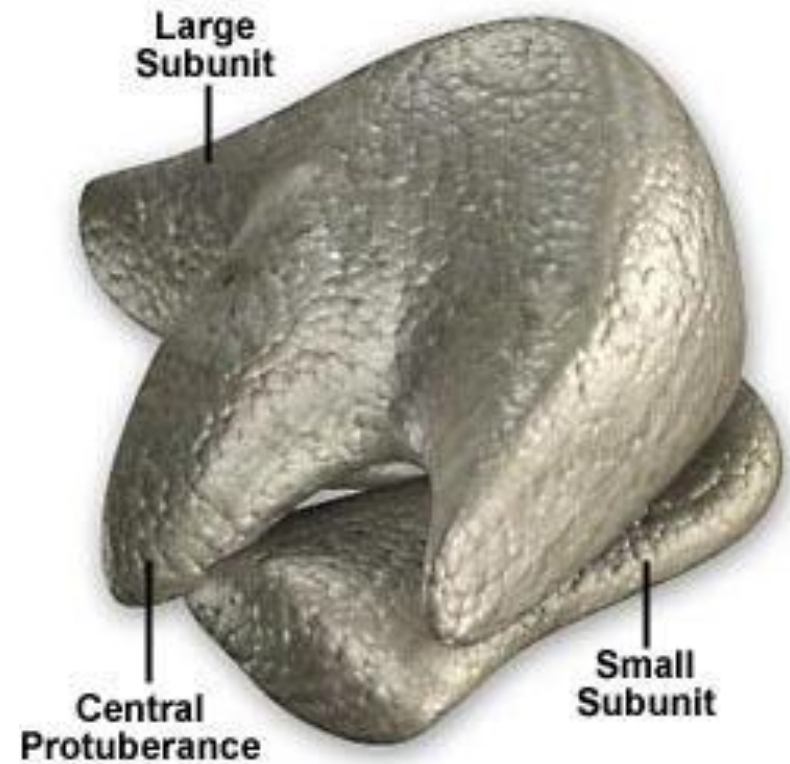


Figure 1

Endoplasmaatiline retiikum

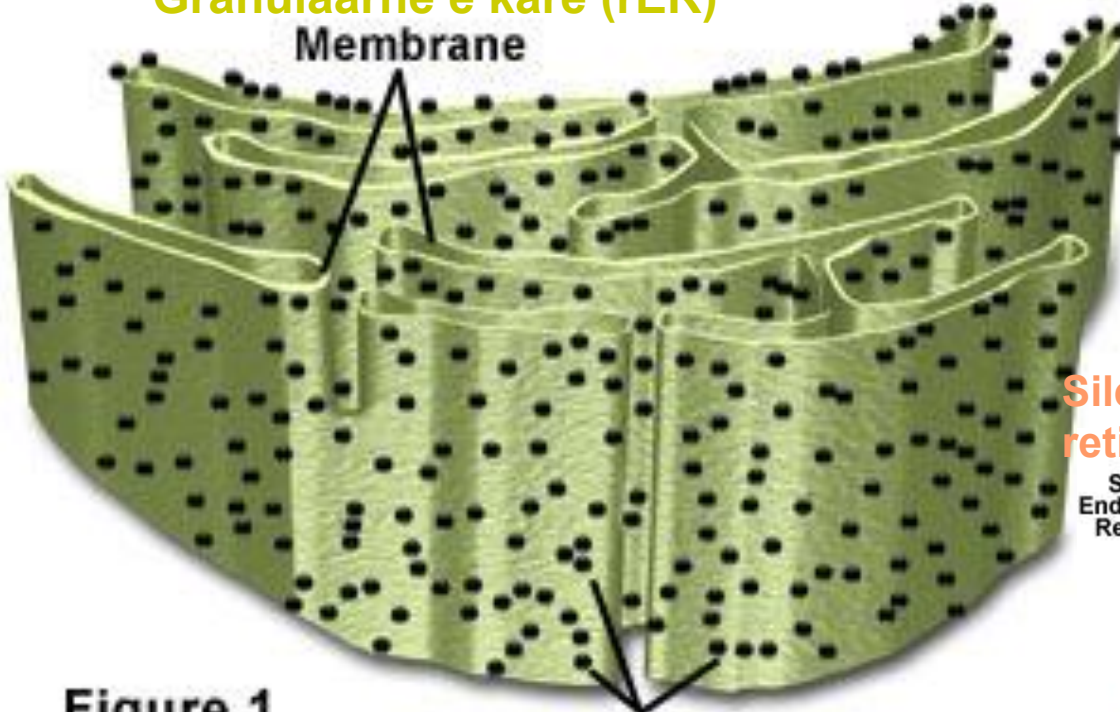


Randy Moore, Dennis Clark, and Darrell Vodopich, Botany Visual Resource Library © 1998 The McGraw-Hill Companies, Inc. All rights reserved.

Rough Endoplasmic Reticulum

Granulaarne e kare (rER)

Membrane



Ribosomes

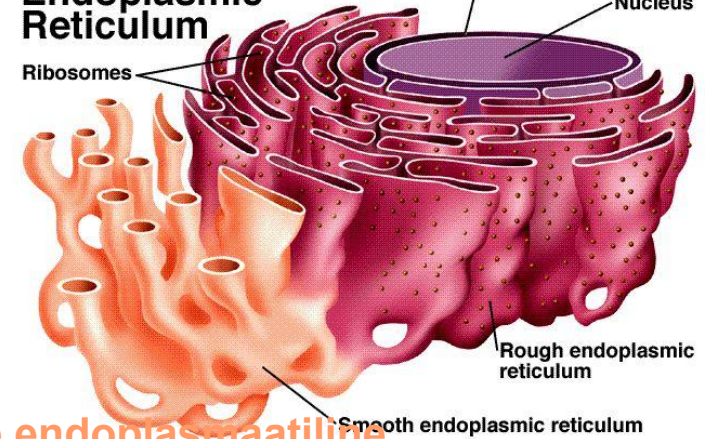
Figure 1

Three-Dimensional Endoplasmic Reticulum

Ribosomes

Nuclear envelope

Nucleus



Rough endoplasmic reticulum

Smooth endoplasmic reticulum

Sile endoplasmaatiline retiikum (sER)

Endoplasmic Reticulum

Smooth Endoplasmic Reticulum

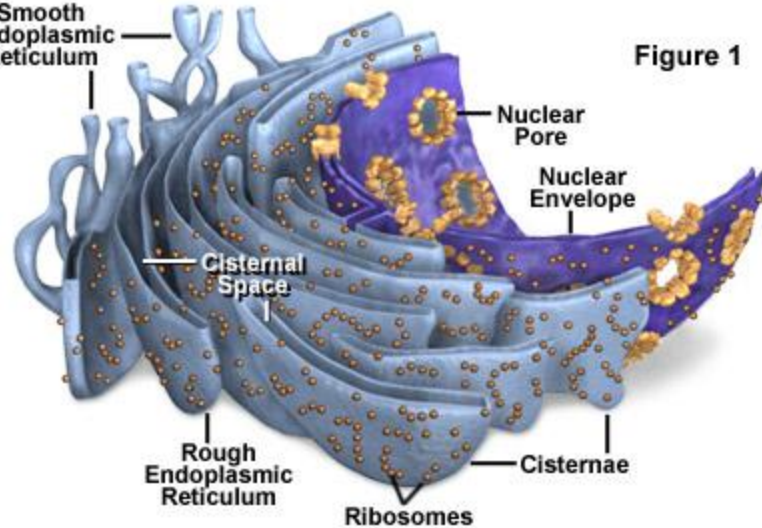
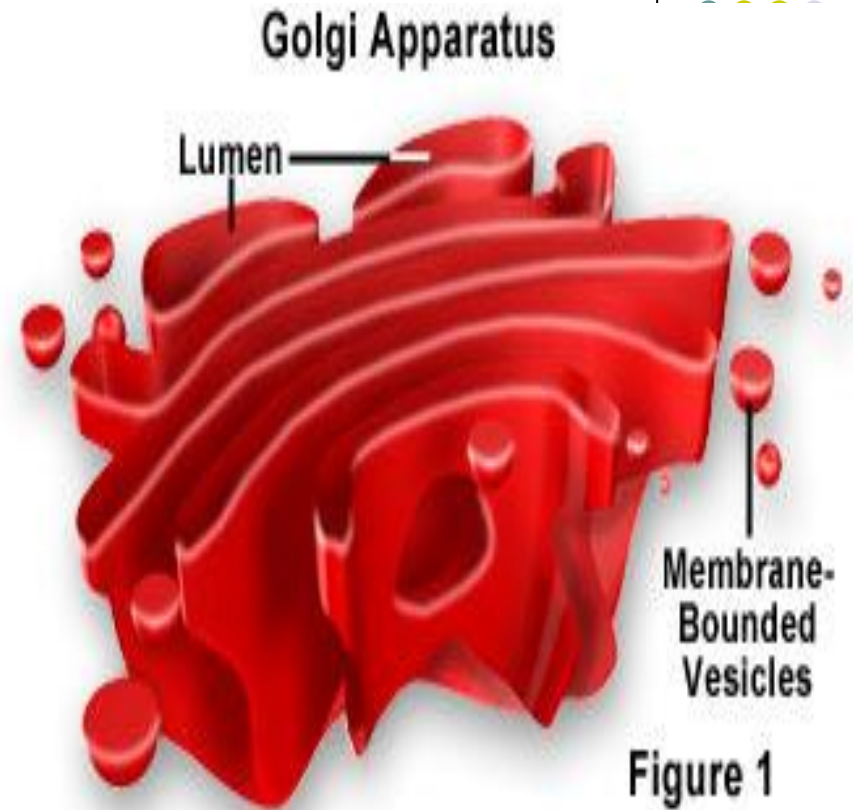
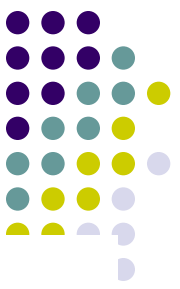


Figure 1

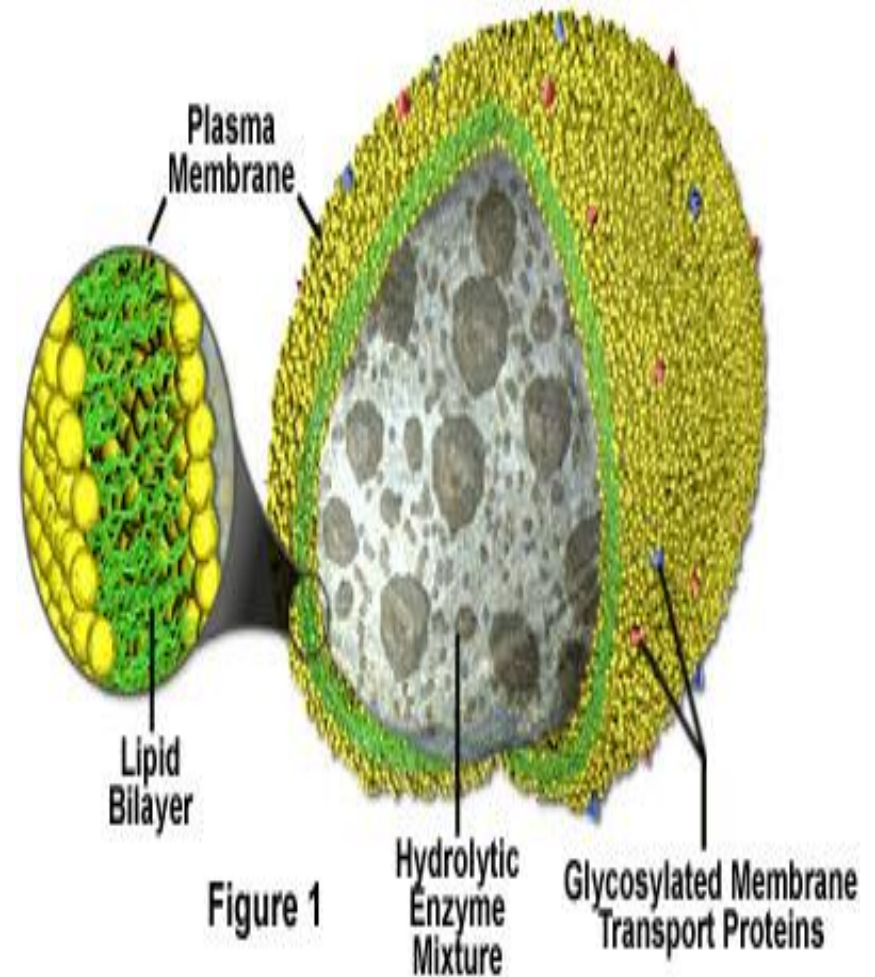
Golgi apparaat e Golgi kompleks



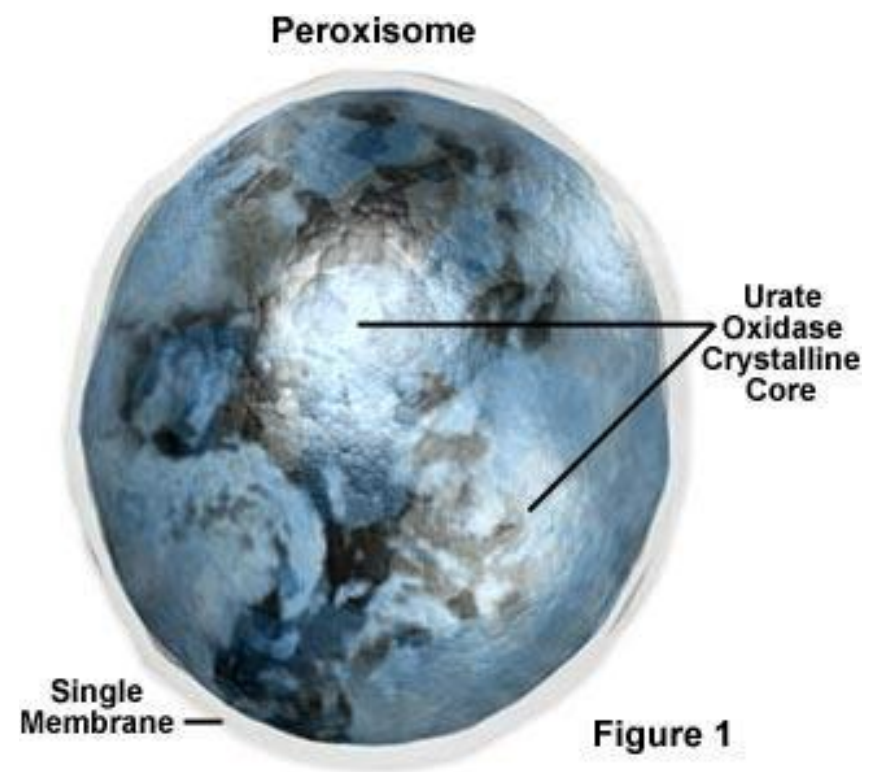
Lüsooomid (*lysis* + *soma* kr. keeles)



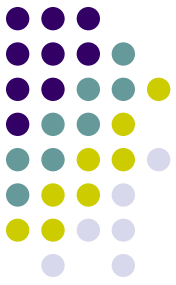
Anatomy of the Lysosome



Peroksisoomid



Tsentrivol

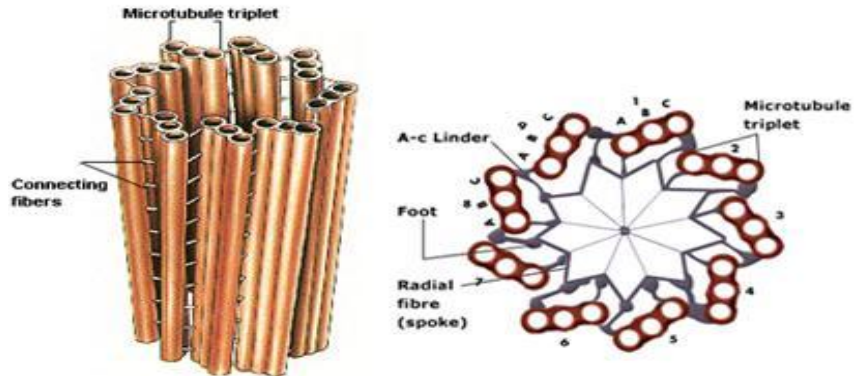


Centriole Structure

Centriole Pair

Microtubule Triplet

Figure 1



Tuum, tuumake

The Cell Nucleus

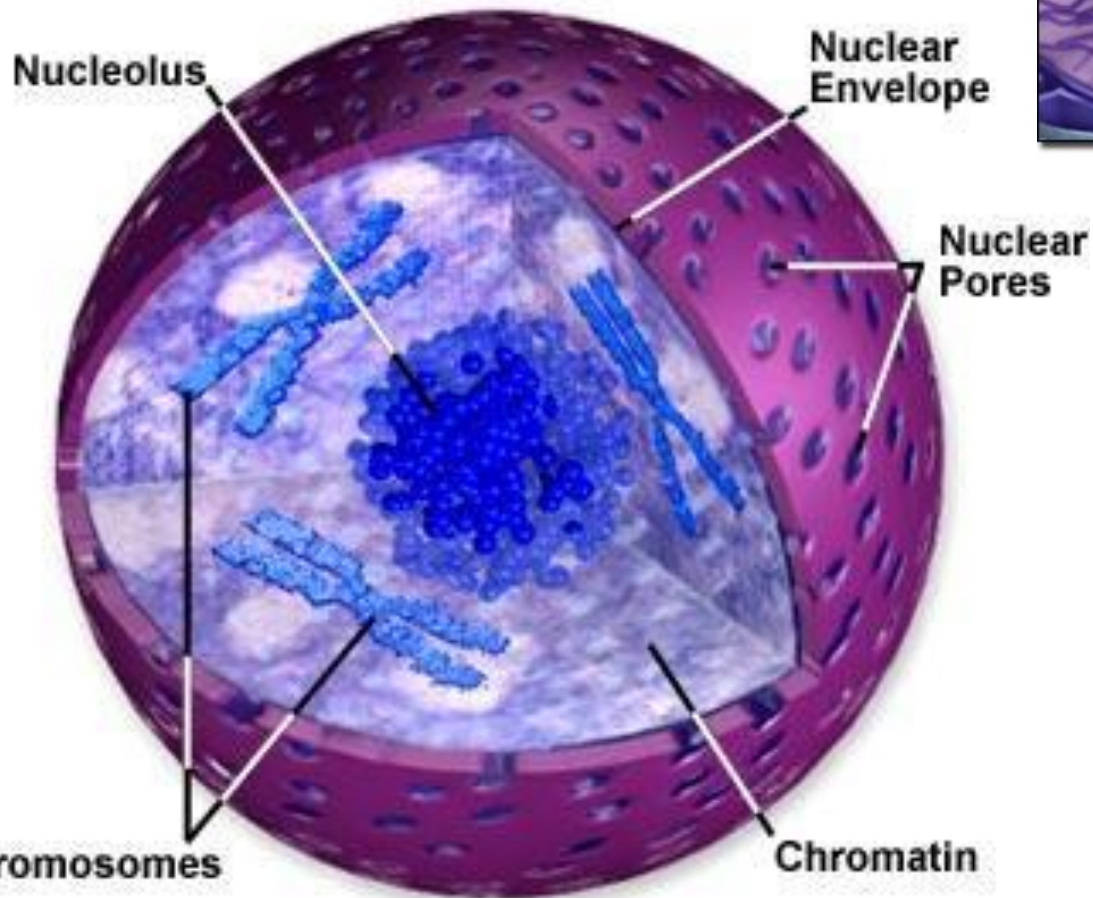
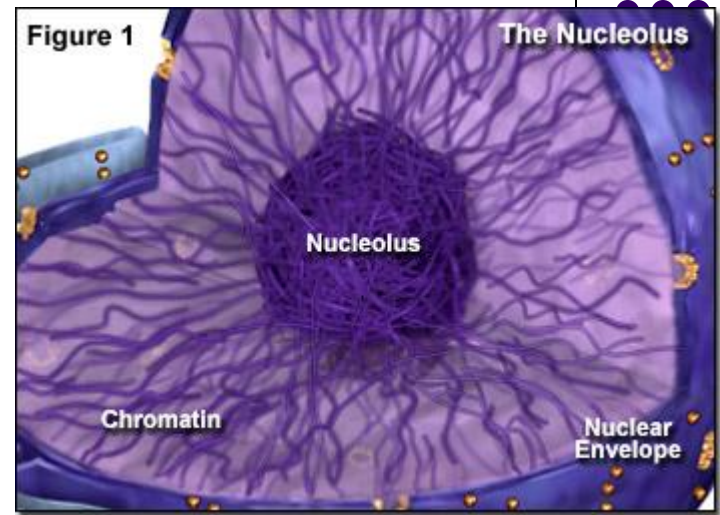
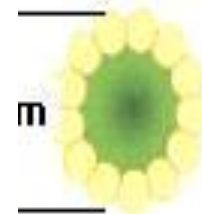
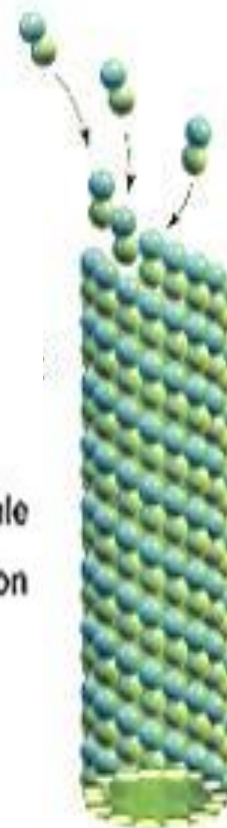
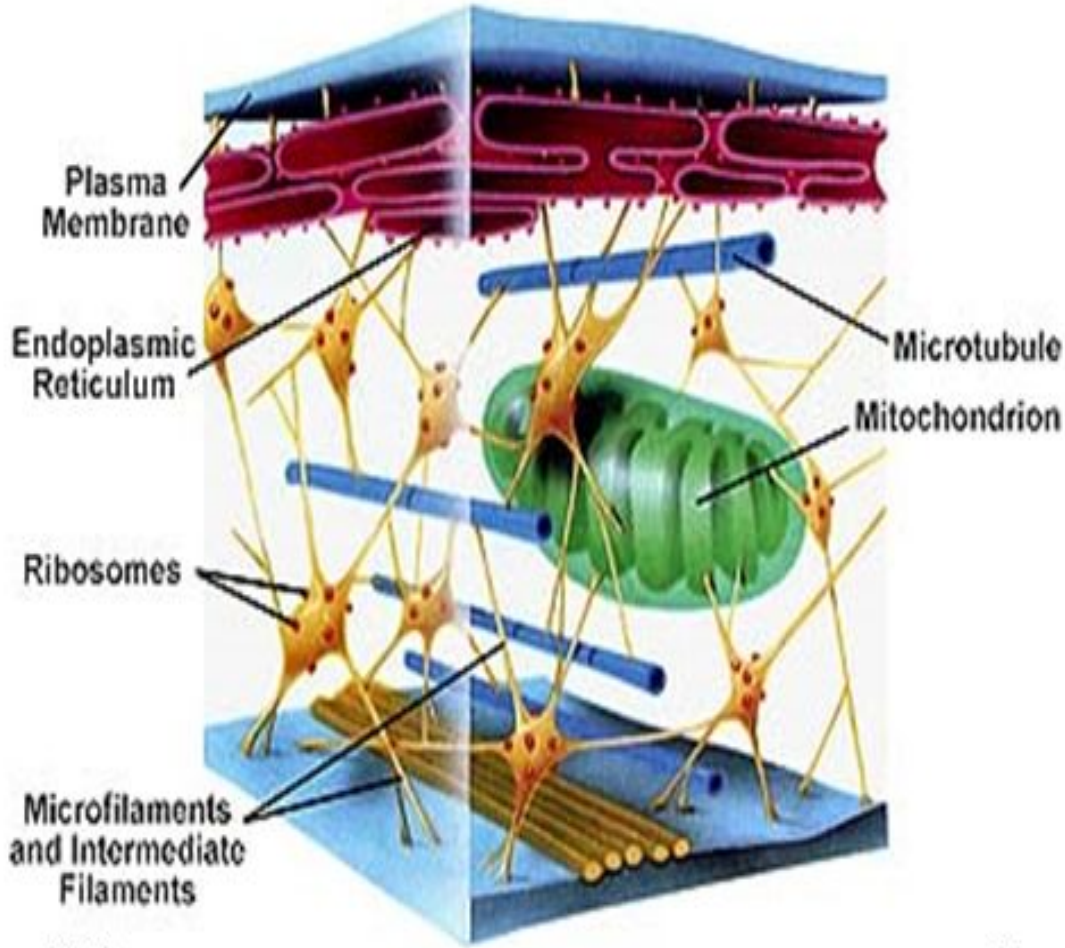


Figure 1



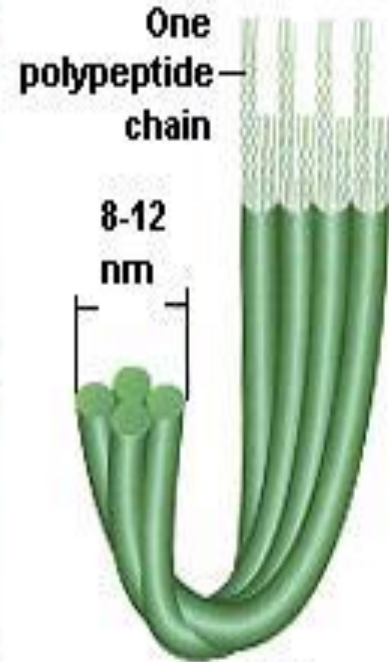
Tsütoskelett (mikrotuubulid, filamendid)



a. Part of a microtubule

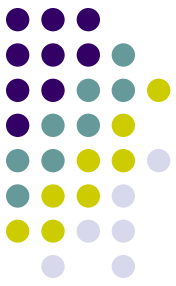


b. Part of a microfilament

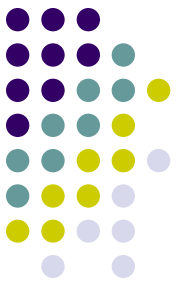


c. Part of an intermediate filament

Rakkude hulga regulatsioon



- Hulkrakse organismi areng seisneb rakkude kasvus, jagunemises ja diferentseerumises.
- Embrüonaalstaadiumi alguses jagunevad kõik rakud kiiresti, kuid erinevusi leidub diferentseerunud rakkude jagunemisvõimes.
- Mõningad rakud (enamik vererakke, mõned epiteelirakud, seemnerakud jt) on lühiealised, sest nemad või nende eelvormid peavad kiires tempos pidevalt jagunema. Näiteks inimese soole epiteelirakud uuenevad umbes kord viie päeva tagant.
- Mõningad rakud jagunevad võrdlemisi harva, näiteks kord kuus (maksarakud).
- Kolmandad kaotavad diferentseerudes jagunemisvõime. Näiteks on närvirakud.
- Rakutsükkel ehk raku jagunemistsükkel on raku elukäik pooldumisest pooldumiseni.



Rakkude paljunemine

- Mitoos -mitoosi all mõeldakse raku tuuma jagunemist koos sellega kaasneva tsütoplasma jagunemisega.
- Meioos -ainult sugurakkud — munarakkude ja seemnerakkude — moodustumisel

Apoptosis – raku programmeeritud surm füsioloogilistes tingimustes



Cellular changes observed with apoptotic cell death



1) sparse plasma
heterogeneous
chromatin



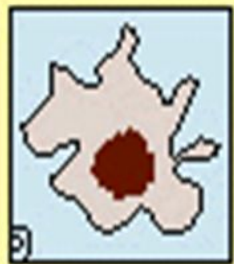
2) volume loss
chromatin clumping
cytoplasmic organelles
tightly packed



3) zeiosis



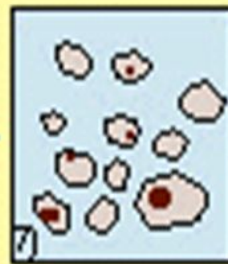
4) chromatin margination
(condensed)



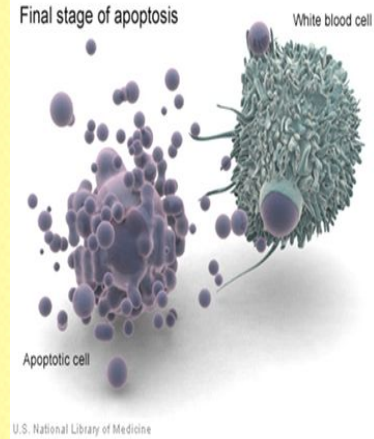
5) collapse of nucleus



6) nucleus breaks up
into spheres
DNA fragmentation



7) apoptotic bodies
No spilling of contents
No inflammation

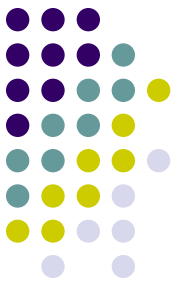


Final stage of apoptosis

White blood cell

Apoptotic cell

U.S. National Library of Medicine



Kasutatud kirjandus

- **Nienstedt, W.** (2007). Inimese füsioloogia ja anatoomia. Tallinn: AS Medicina.
- **Ross, M., Kaye G., Pawlina, W.** (2003). Histology. Philadelphia: Lippincott Williams and Wilkins.
- **Ross, M., Pawlina, W.** (2006). Histology. Philadelphia: Lippincott Williams and Wilkins.
- www.cartage.org.lb/.../AnimalCellStructure.htm