SITOLOGI

Oleh:
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Bagian Histologi dan Biologi Sel

Prodi Pendidikan Kedokteran
FKIK UMY
2020/2021

TIU & TIK

TIU:

1. Mahasiswa dapat mengetahui konsep sejarah dan makna Cabang Ilmu Sitologi sebagai dasar teori kedokteran umum

2. Mahasiswa dapat menjelaskan komponen penting dalam Ilmu Sitologi sebagai dasar teori kedokteran umum

TIK:

1. Mahasiswa dapat mengetahui sejarah lahirnya cabang ilmu sitologi dan memahami definsi konsep cabang ilmu sitologi sebagai dasar ilmu kedokteran umum

2. Mahasiswa dapat menjelaskan Jenis dan konsep sel sebagai struktur endomembran yang terdiri dari struktur inti yaitu;

a. selaput membran; sebagai pembatas antara lingkungan dalam dan luar sel

b. Sitoplasma; sebagai tempat berbagei struktur organela menjalankan fungsi metabolisme sel, badan inklusi, dan sitoskeleton

c. Nukleus; sebagai struktur pusat pengatur kerja perangkat sel

Pendahuluan

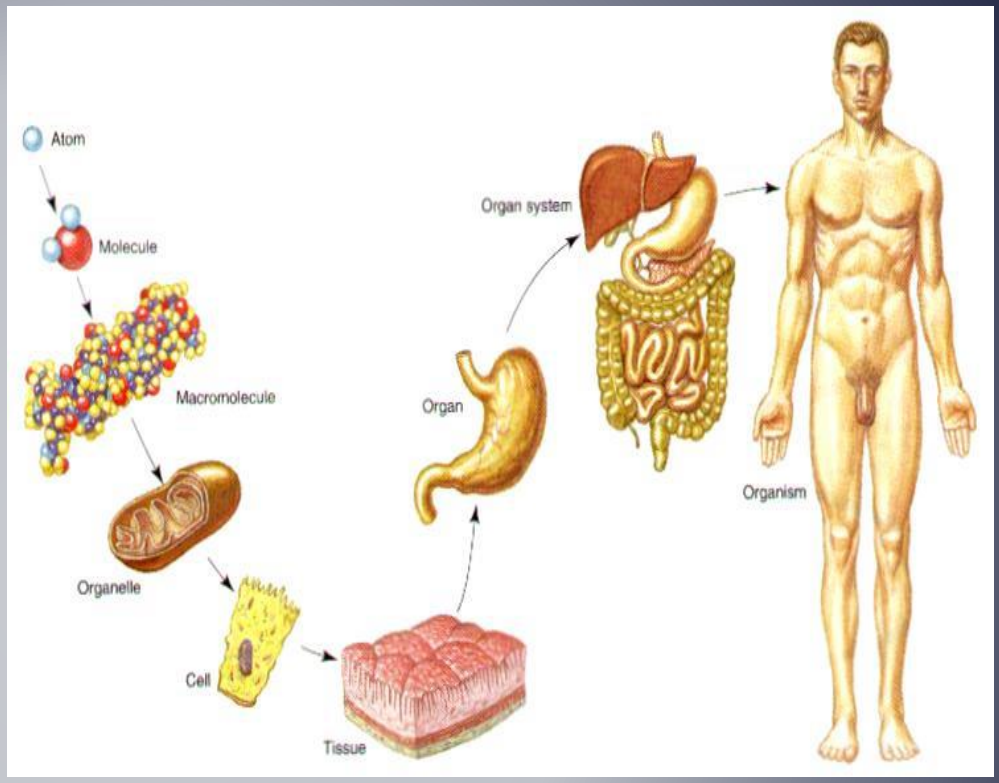
- Studi → sel sebagai kesatuan unit fundamental terkecil
- Perkembangan→

1. Robert Hooke's (1665) : deskripsi mikroskopis sel gabus
2. Matthias Schleiden (1838) & Theodor Schwann (1839)→ sel sebagai partikel fundamental pd tumbuhan & hewan
3. Oscar Hertwig (1892)→ proses yg terjadi dlm organisme adalah refleksi proses selular→sitologi sebagai cabang ilmu tersendiri

Sel

Satuan unit dasar terkecil penyusun struktur & fungsi organisme

- Micoplasma→ sel terkecil pd bakteri (diameter 0,3 um)
- Manusia→ 400.000x dari massa mikoplasma bakteri dgn diameter 20 um

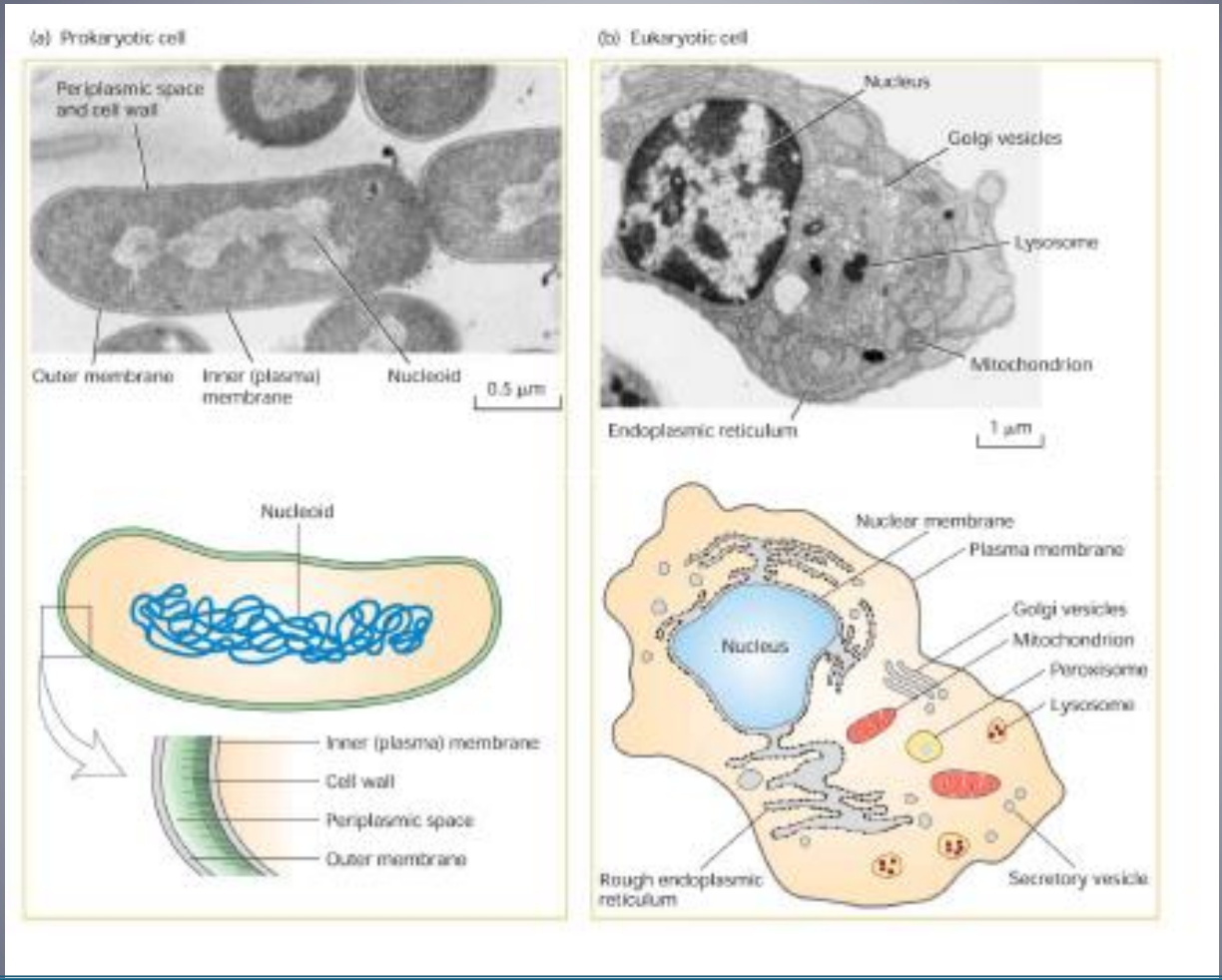


Sifat sel secara individual, Mampu:
-metabolisme →nutrisi
-Sintesis berbagai tipe molekul
-Menghasilkan energi
-Replikasi→regenerasi→ reproduksi seluler (siklus sel)

Dalam organisme multiselular→ Fungsi yg berbeda→ proses diferensiasi→ kesatuan sel dgn struktur yg sama (jaringan)→ kesatuan jaringan dgn fungsi ttu (organ)→ kesatuan organ→ sistem organ

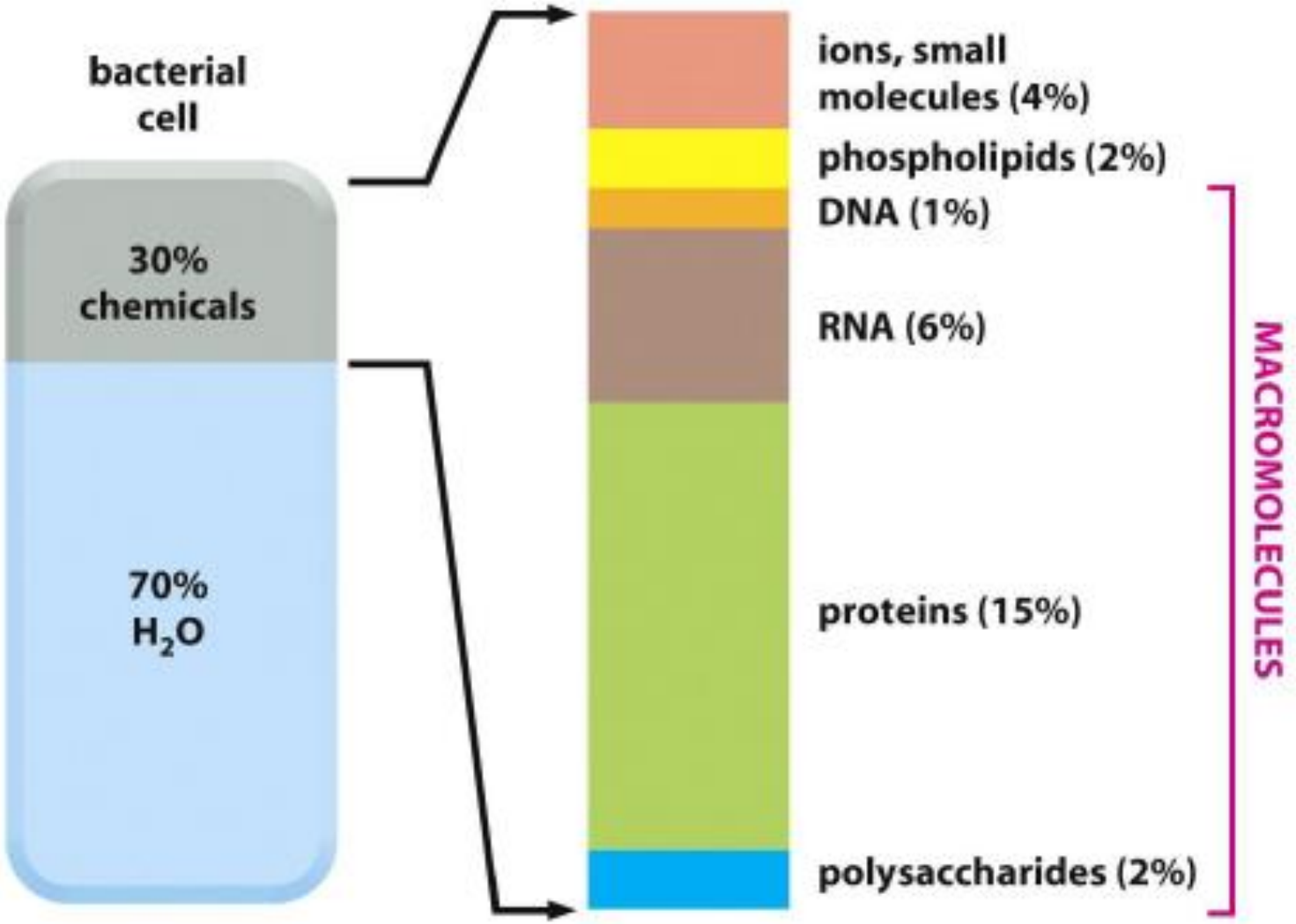
Cells have various shape

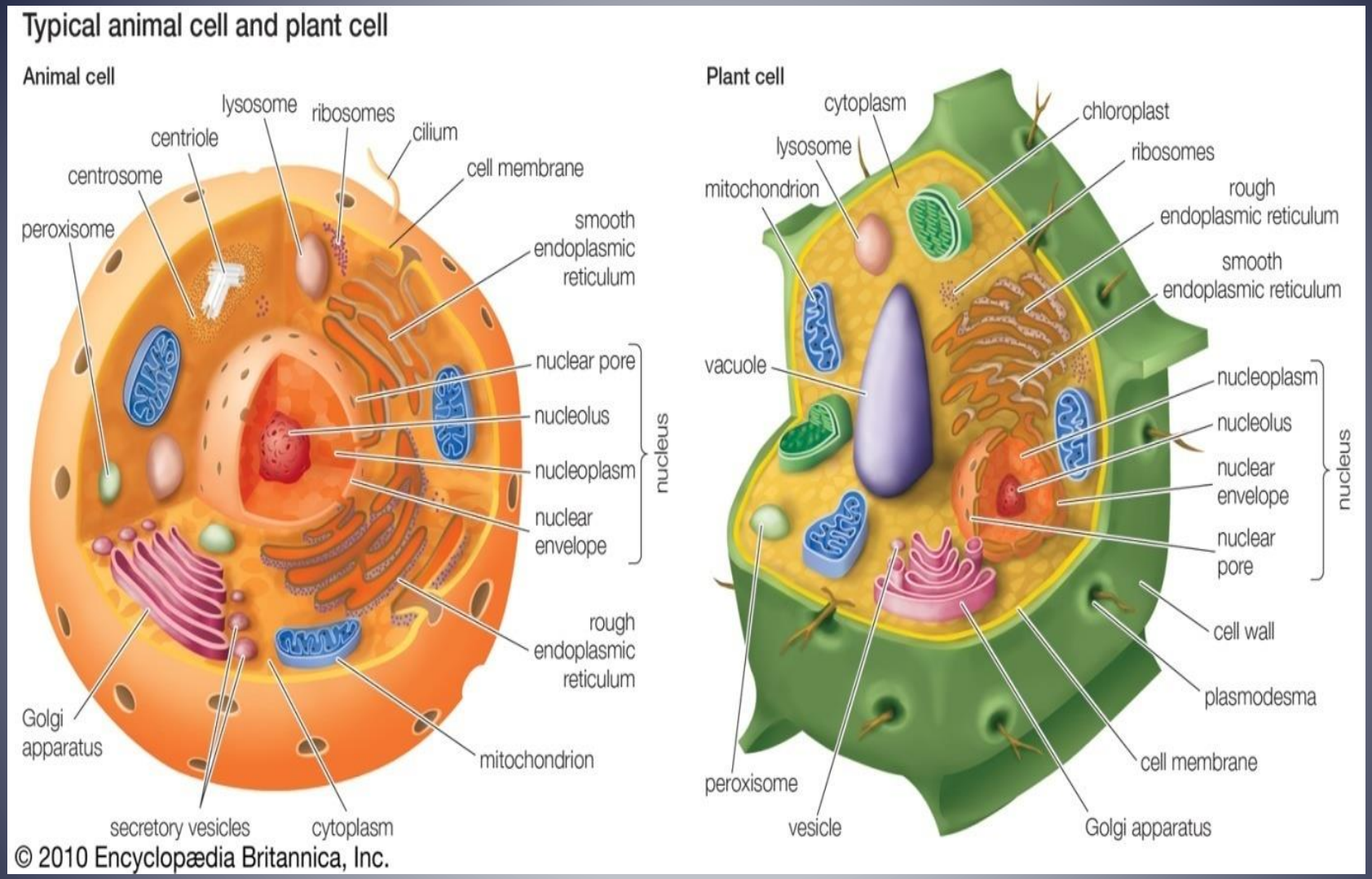
Eukariota VS Prokariota



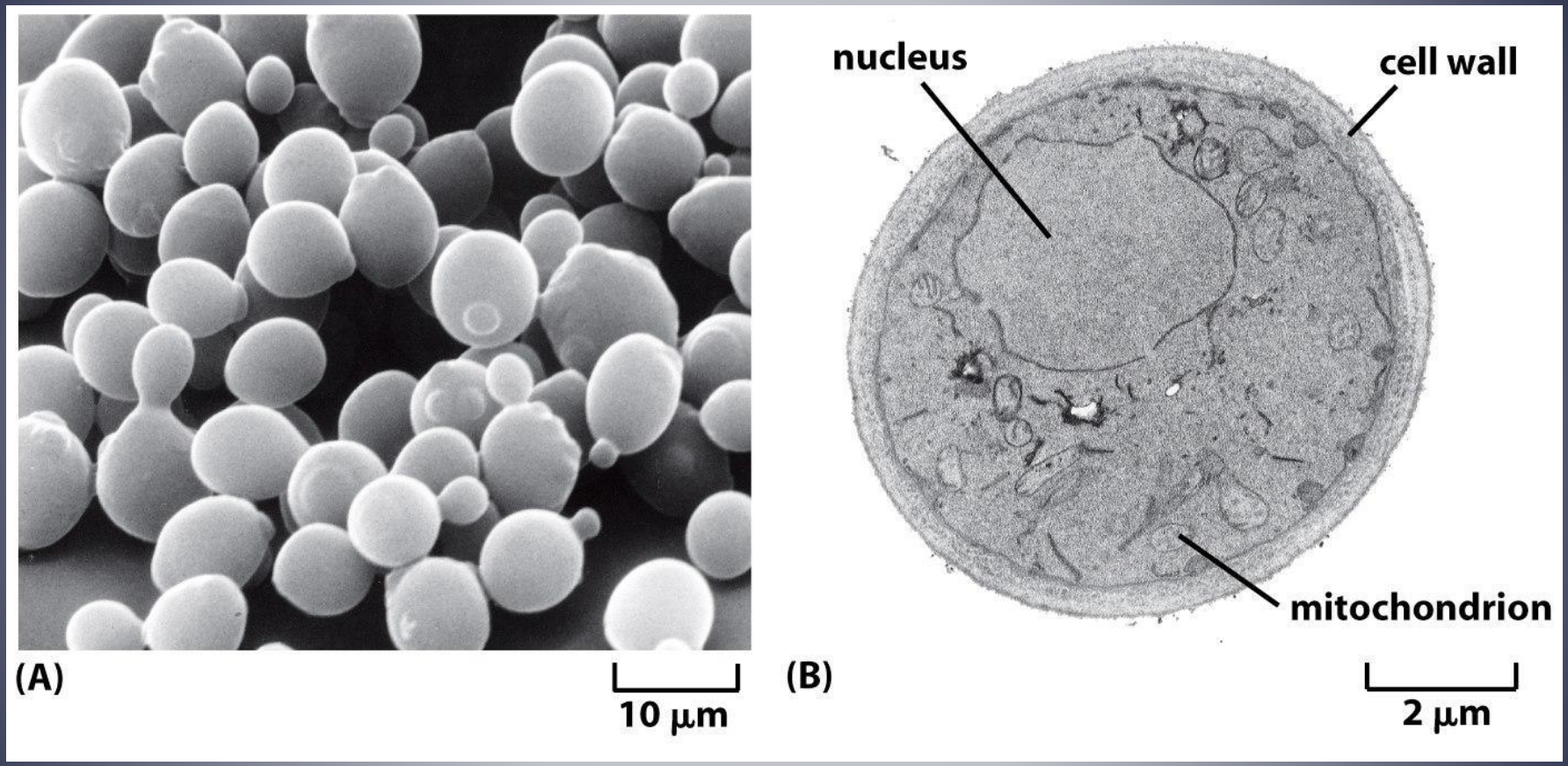
Karakteristik sel dgn organela khusus→ eukariota
tidak memiliki organela,ukuran lebih kecil→prokariota

Main components of cells

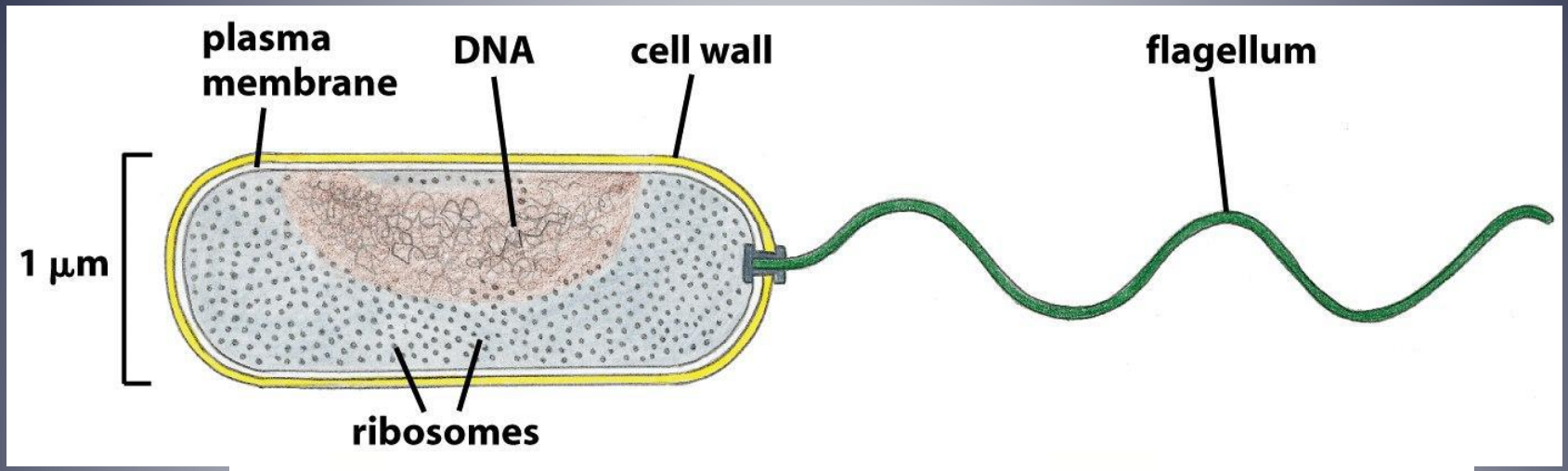


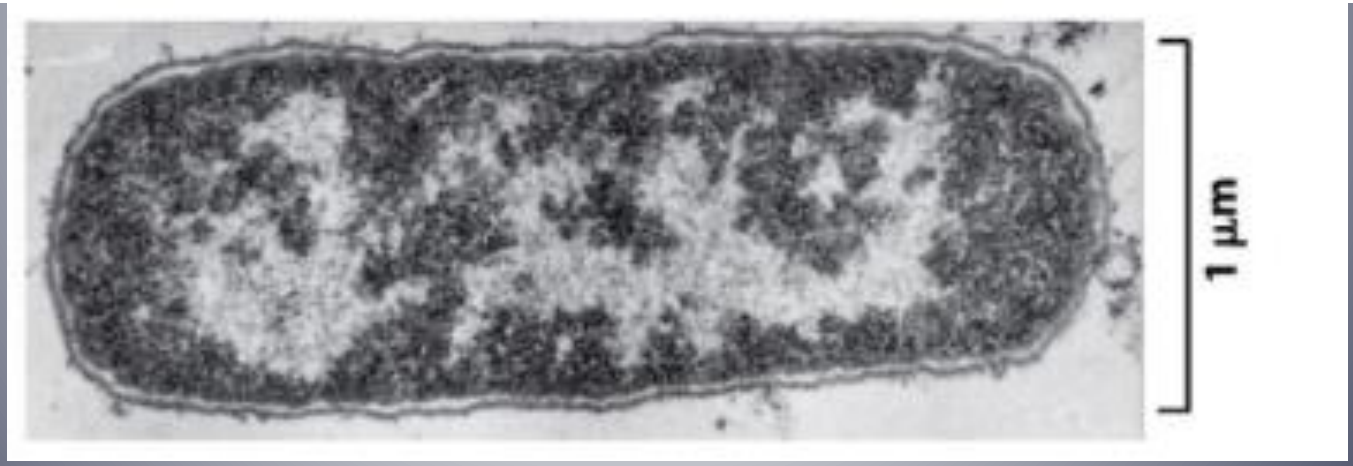


Eukaryotic cells contain membrane-bound organelles, including a clearly defined nucleus

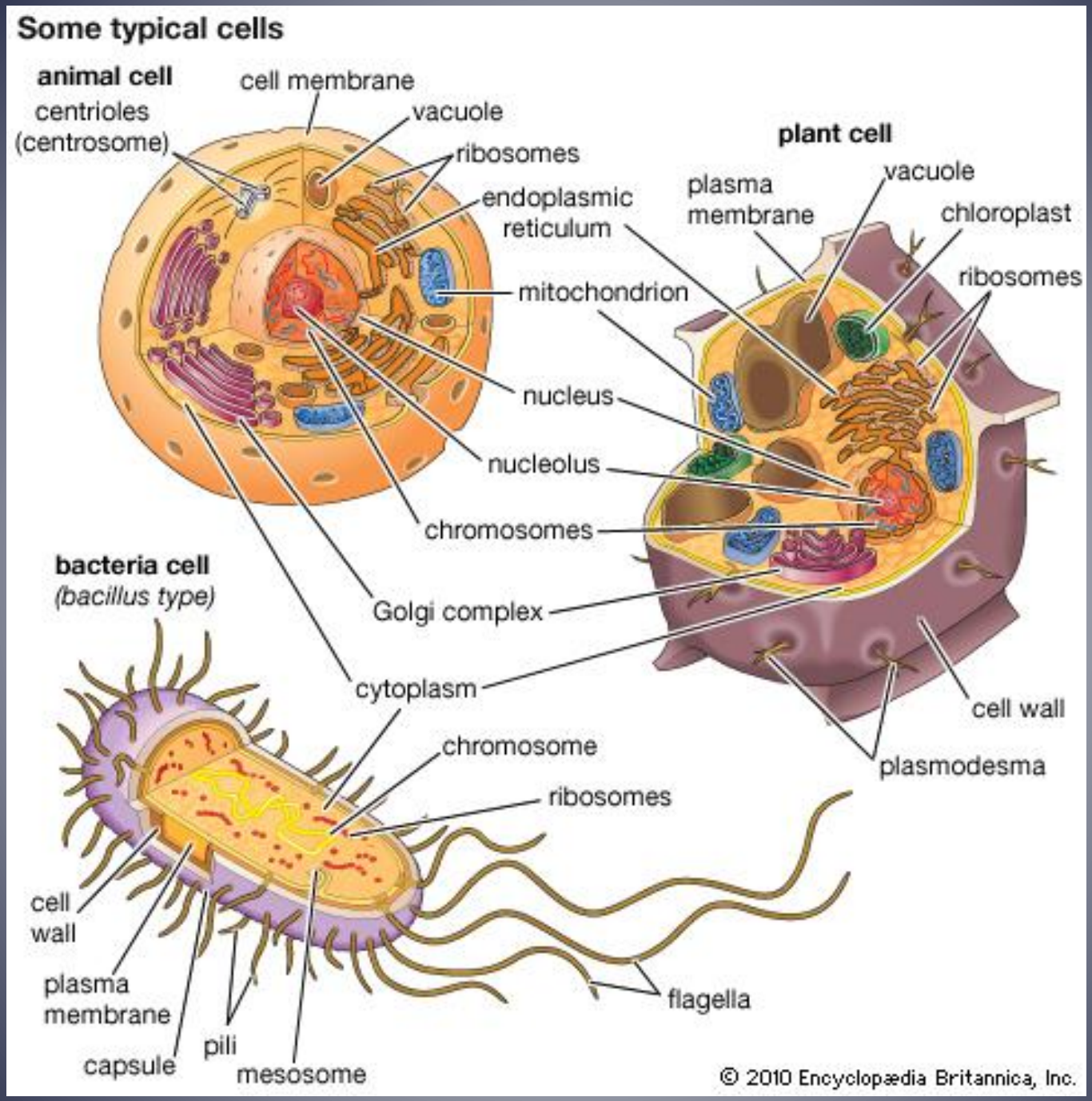


Yeasts, plant and animal cells are eukaryotes





Bacteria are prokaryotes


Some typical cells
animal cell
centrioles (centrosome)
cell membrane
vacuole
ribosomes
endoplasmic reticulum
mitochondrion
nucleus
nucleolus
chromosomes
Golgi complex
cytoplasm
plant cell
plasma membrane
vacuole
chloroplast
ribosomes
cell wall
plasmodesma
bacteria cell
(bacillus type)
chromosome
ribosomes
cell wall
plasma membrane
capsule
pili
mesosome
flagella
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Prokaryotes vs Eukaryotes (animal and plant)

Table 5.2 A Comparison of Bacterial, Animal, and Plant Cells

	Bacterium	Animal	Plant
EXTERIOR STRUCTURES			
Cell wall	Present (protein-polysaccharide)	Absent	Present (cellulose)
Cell membrane	Present	Present	Present
Flagella	May be present (single strand)	May be present	Absent except in sperm of a few species
INTERIOR STRUCTURES			
ER	Absent	Usually present	Usually present
Ribosomes	Present	Present	Present
Microtubules	Absent	Present	Present
Centrioles	Absent	Present	Absent
Golgi apparatus	Absent	Present	Present
Nucleus	Absent	Present	Present
Mitochondria	Absent	Present	Present
Chloroplasts	Absent	Absent	Present
Chromosomes	A single circle of DNA	Multiple; DNA-protein complex	Multiple; DNA-protein complex
Lysosomes	Absent	Usually present	Present
Vacuoles	Absent	Absent or small	Usually a large single vacuole

Sel Sebagai Struktur Kompartemen Tertutup

1. Membran sel (membran plasma/plasmalemma)→ membatasi lingkungan ekstrasel→ barier selektif utk keluar masuk nutrisi/produk buangan

2.Sitoplasma→ mengitari nukleus, dibungkus membran plasma, terdiri dari sitosol

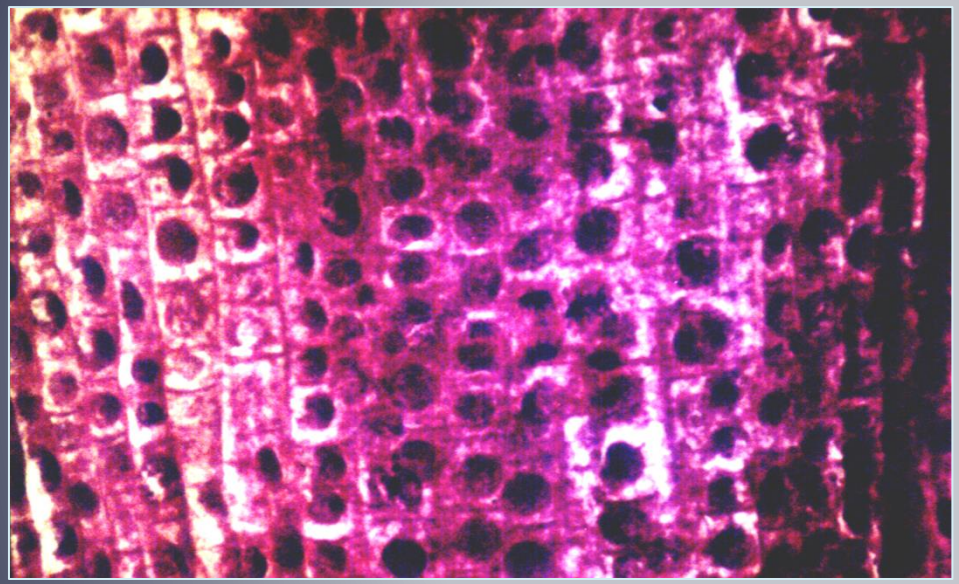
- Organela; struktur metabolik aktif →sistem endomembran exp mitokondria & tdk bermembran (ribosom,proteosom)

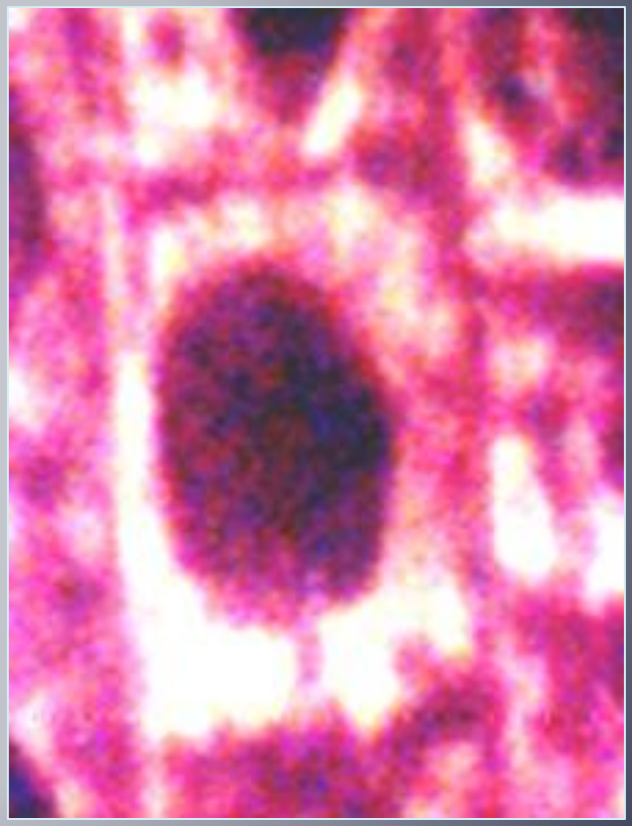
- Inklusion sitoplasmik→ produk metabolisme intraseluler exp tetes lemak,granula glikogen

- sitoskeleton→ kerangka sel dgn anyaman filamentosa (bentuk sel& motilitas sel)

3. nukleus→pusat informasi genetik penting untuk pertumbuhan & reproduksi

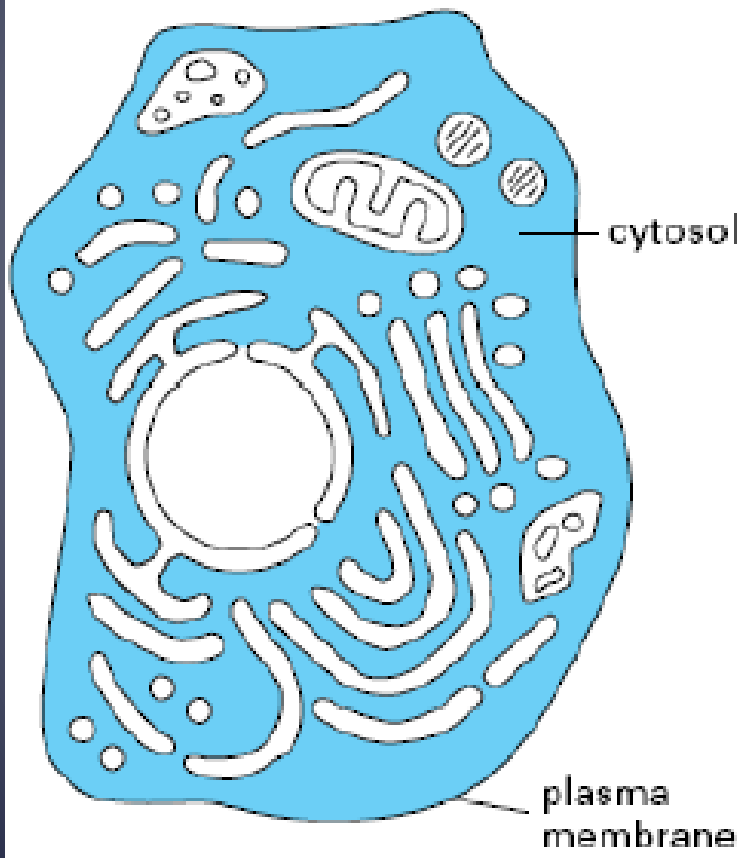
Mikroskopis Sel (Perbesaran Obyektif 10x & 40x)

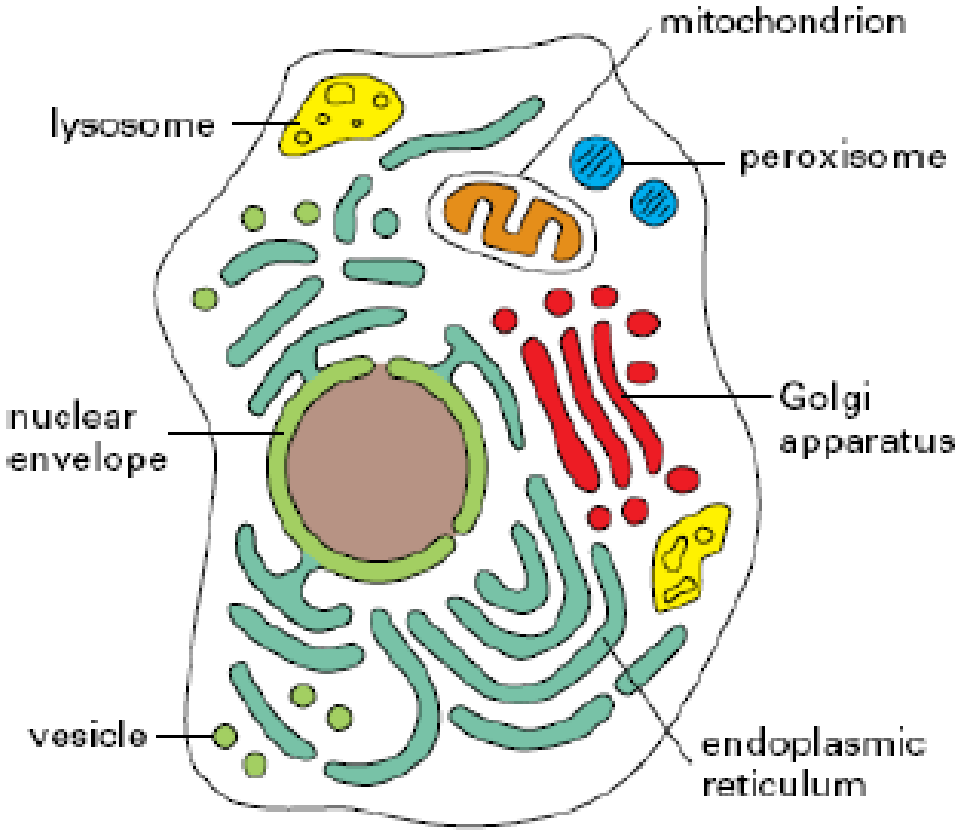




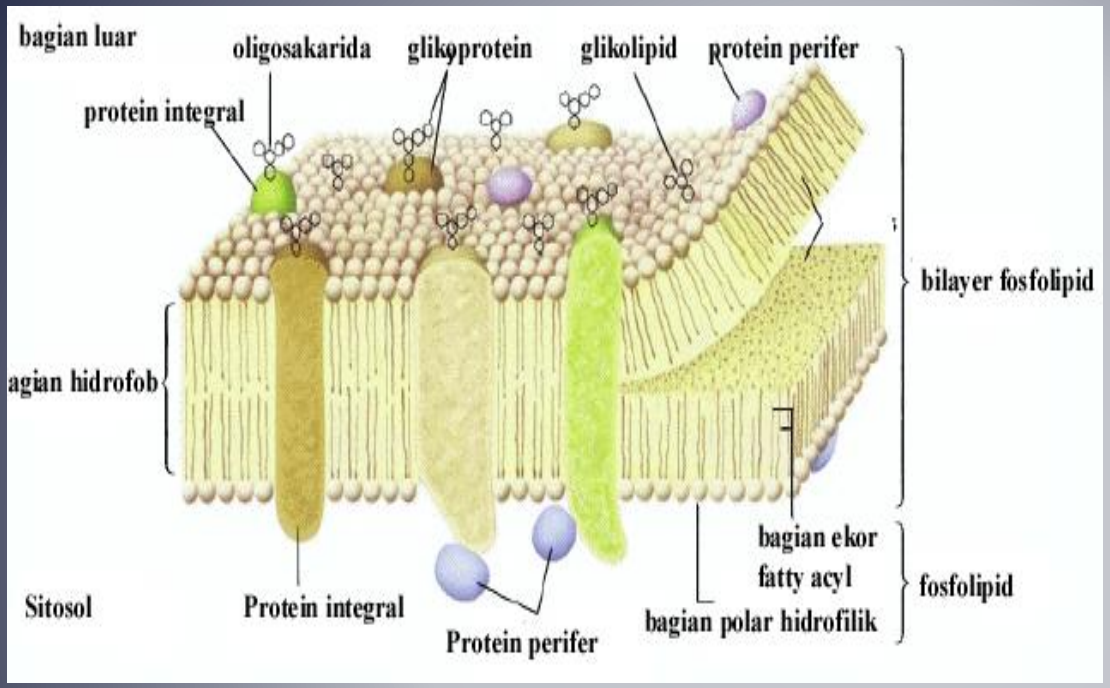
Cell is a closed compartment

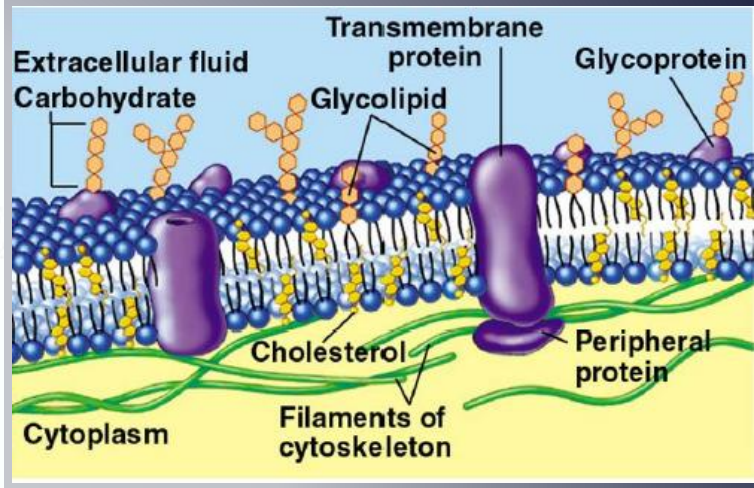
separated from extracellular space by cell membrane, consists of cytosol & intracellular organelles





Membran Sel→ Membran Plasma (Plasmalemma)



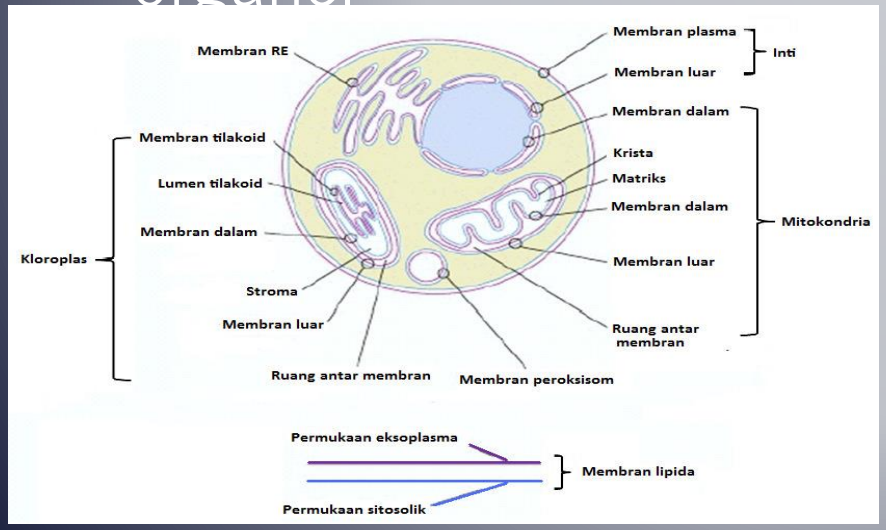


Membantu transportasi molekul spesifik (tebal 7,5-10 nm),
Komponen :
-Fosfolipid
- kolesterol,
-protein (50% membran)→ integral & perifer→ transduksi sinyal
- Karbohidrat (rantai oligosakarida)→ glikokaliks (pengenalan & perlekatan sel)

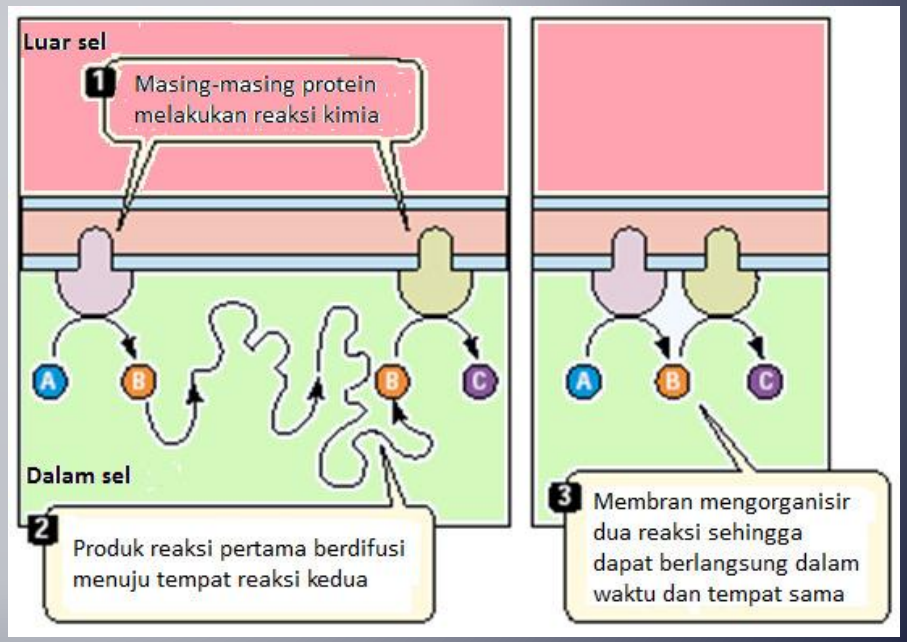
Fungsi Membran Sel

1. Pembatas

- lapisan yang bersinambungan
- melingkupi sel, inti, organel

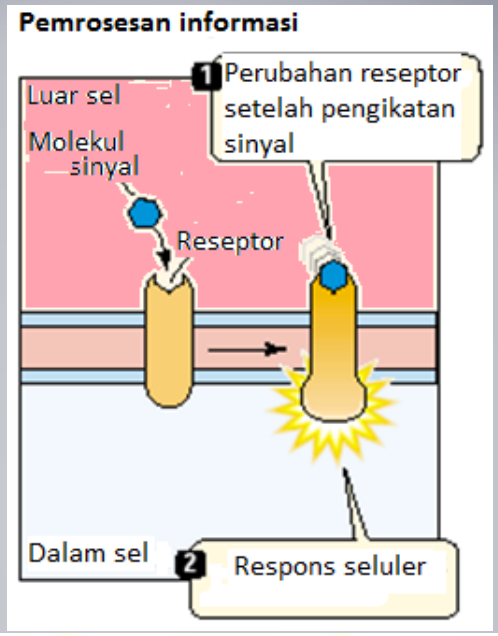


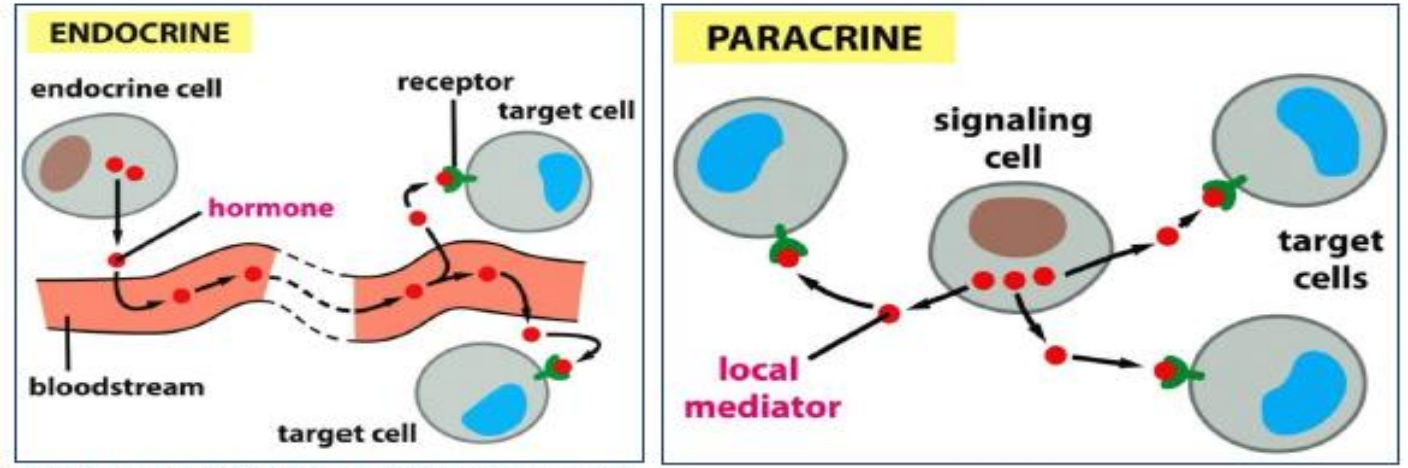
2.mendukung aktivitas biokimia yang berlangsung di dalam sel



Fungsi Membran Sel

3.komunikasi antara sel→ Memberikan respons terhadap rangsangan luar





Fungsi Membran Sel

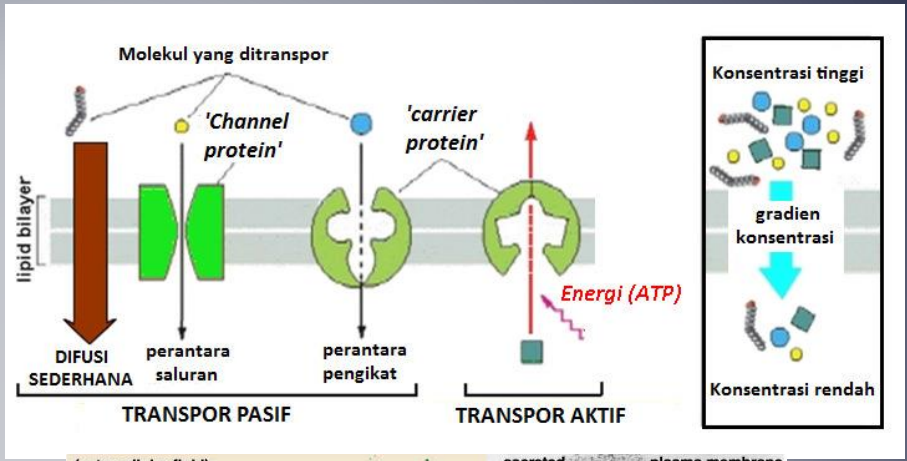
2.Pembatas yang bersifat selektif permeabel

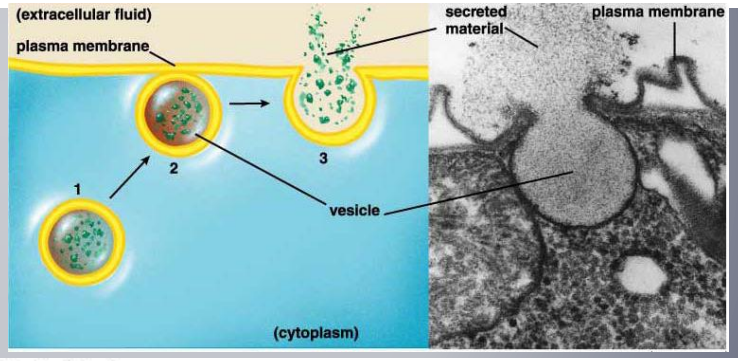
- pertukaran zat antara sel & lingkungannya→ Transpor membran→

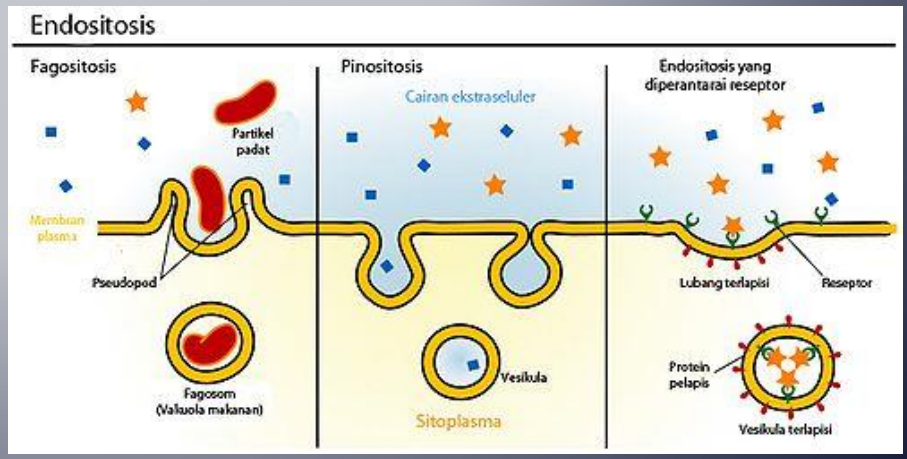
a.Transpor pasif (Difusi, Difusi terfasilitasi, Osmosis) exp: able to dissolve) in lipids, small monosaccharides, water, oxygen, carbon dioxide, sex hormones, etc.

b.Transpor aktif (transpor melalui pompa sodium-potassium→ATP energi, exp: proteins, ions, large cells, complex sugars

c. Transpor makromolekul Endositosis & Eksositosis)



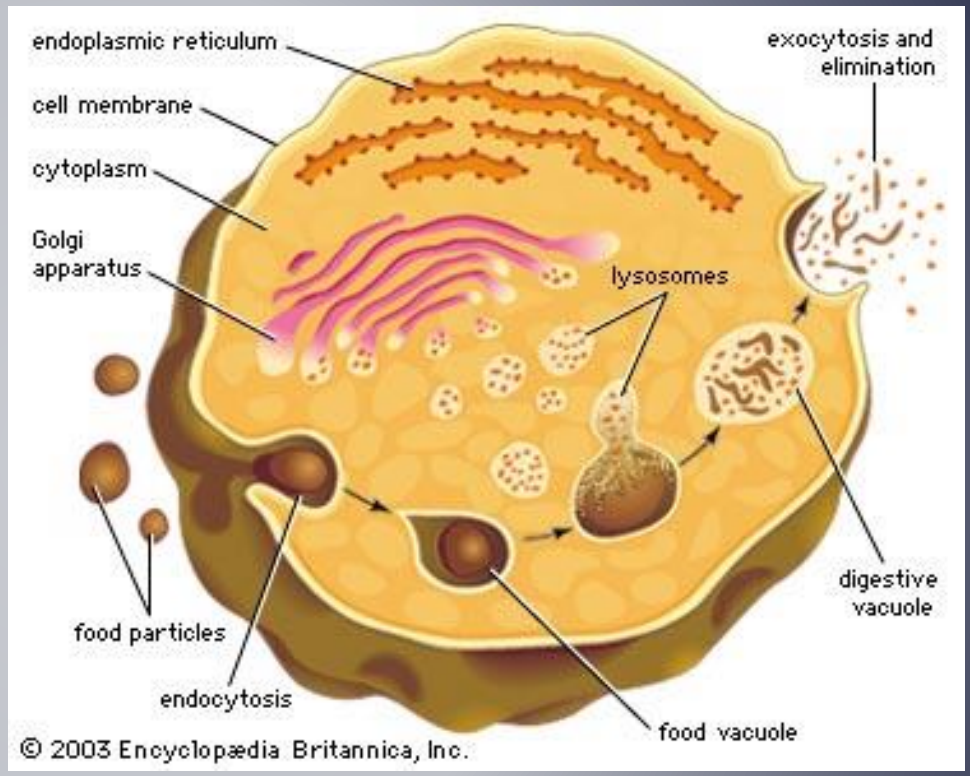




Endositosis & Eksositosis

- Endositosis (mengambil material dari cairan ekstrasel dgn gerakan dinamis & penggabungan membran sel → struktur sitoplasmik bermembran berisi material

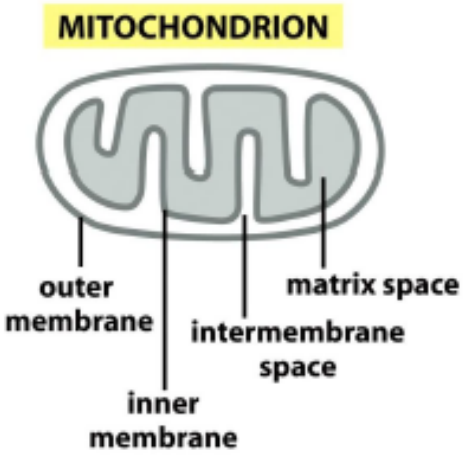
- Eksositosis (vesikel sitoplasmik berbatas membran menyatu dgn membran plasma dan melepas isinya ke ekstrasel)

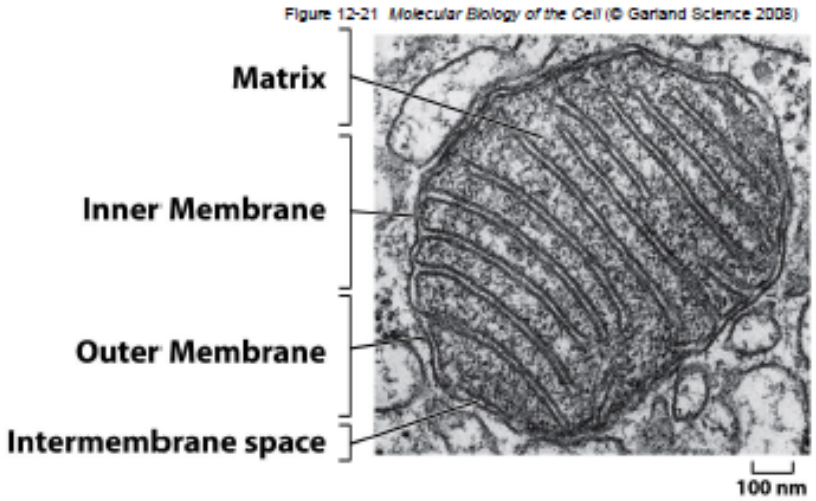


Mitokondria

Center of energy production

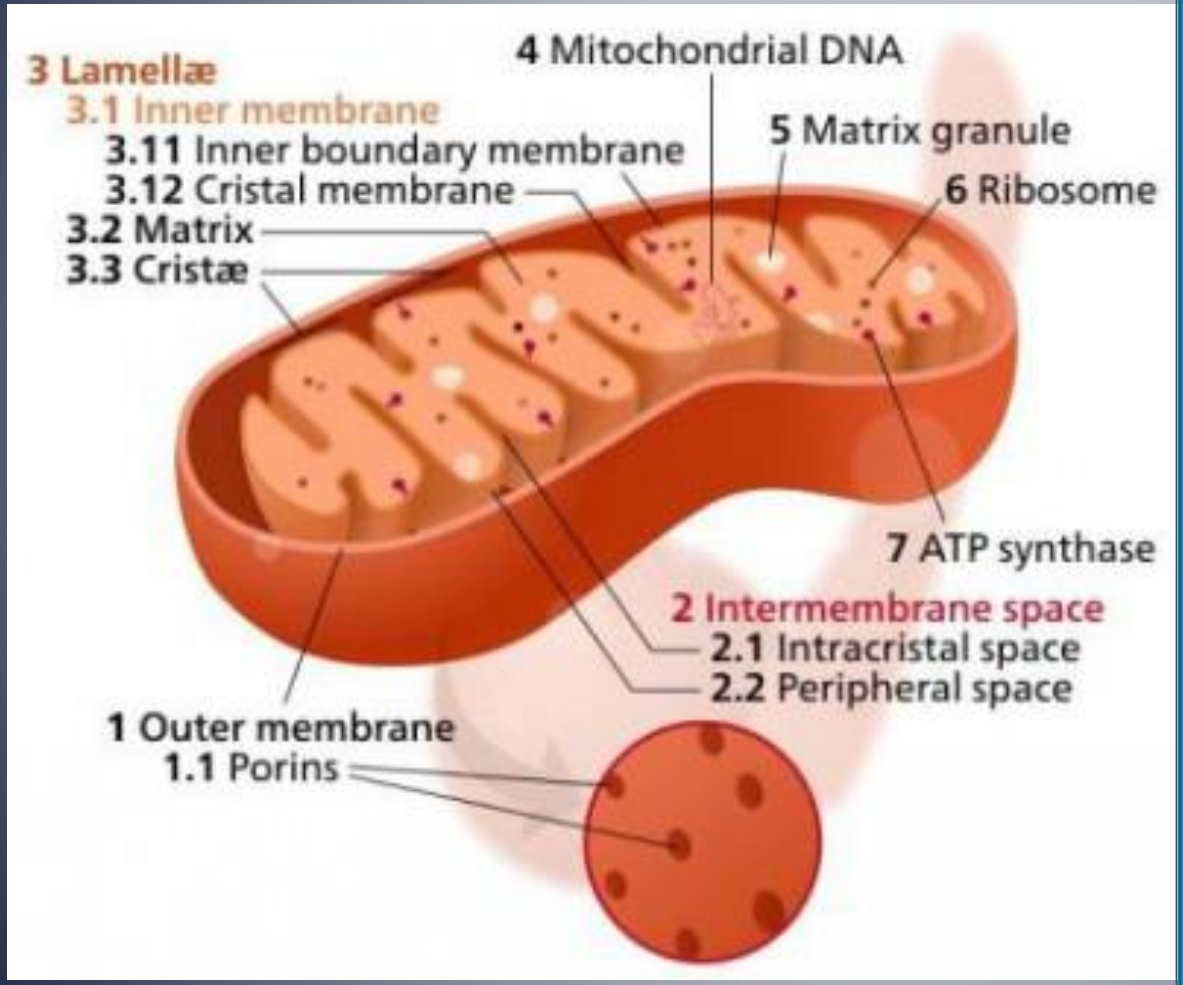
A mitochondrion is bounded by **two membranes**: a smooth outer membran amd inner one which is folded into numerous contiguous layers called **cristae**





- The cristae partition the mitochondrion into two compartments: a **matrix**, lying inside the inner membrane; and **intermembrane space**

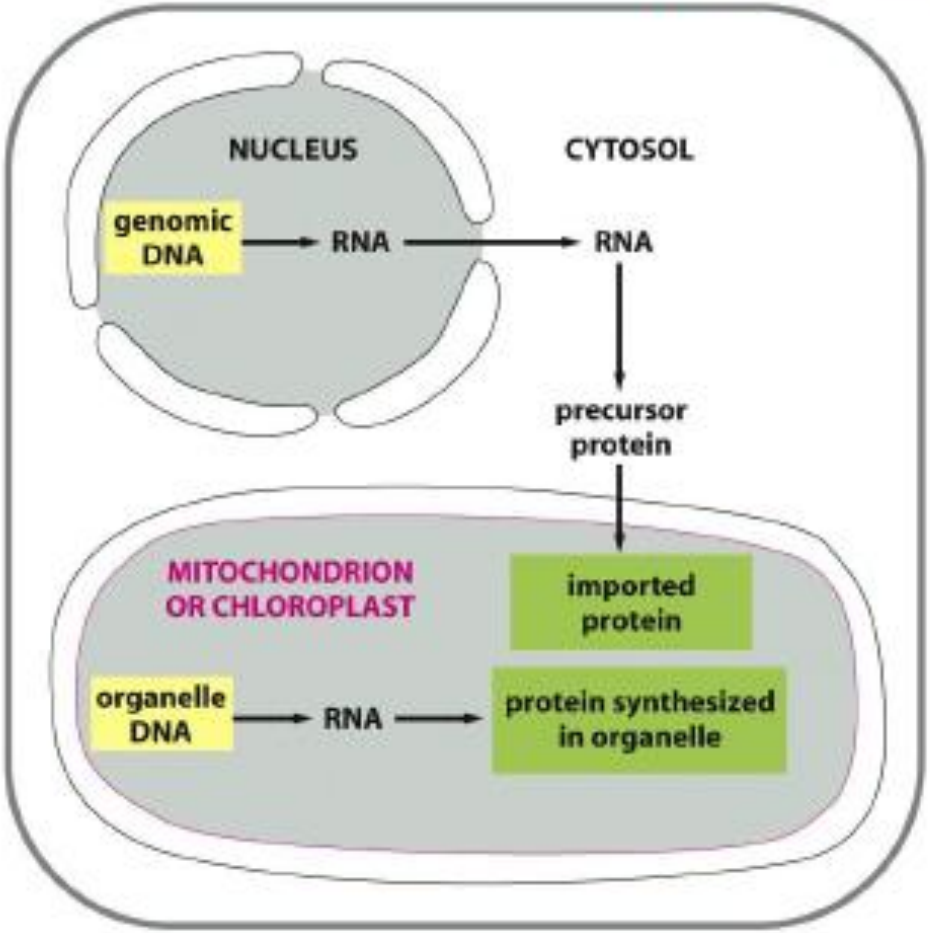
Struktur Mitokondria

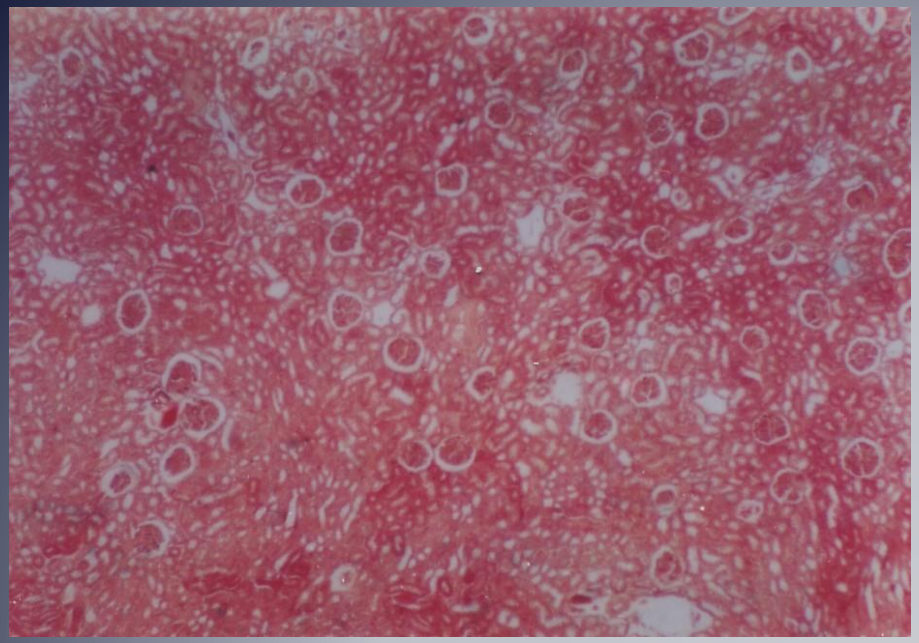


-Sebesar uk bakteri : p 2-6um, D 0,2 um
-Bentuk sferis, ovoid, filamentosa
-Matriks: enzim larut air & granula (siklus krebs,b-oksidasi lipid,& sintesis DNA)
-Fungsi: sumber energi →kerja kimiawi& mekanik (timbunan energi metabolit seluler pd ikatan ATP energi-tinggi)
-Lokasi: hampir semua sel eukariotik tersebar di sitoplasma

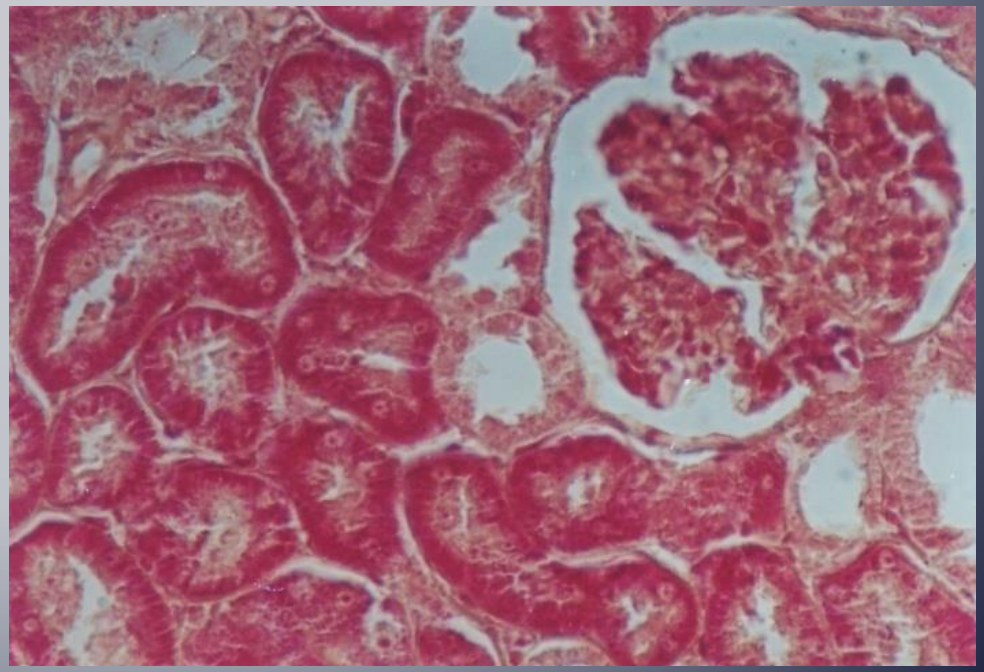
Mitochondria have circular DNA in the matrix and may produce protein inside the organelles. However, they also imported proteins encoded by nuclear genes

Figure 14-53 *Molecular Biology of the Cell* (© Garland Science 2008)

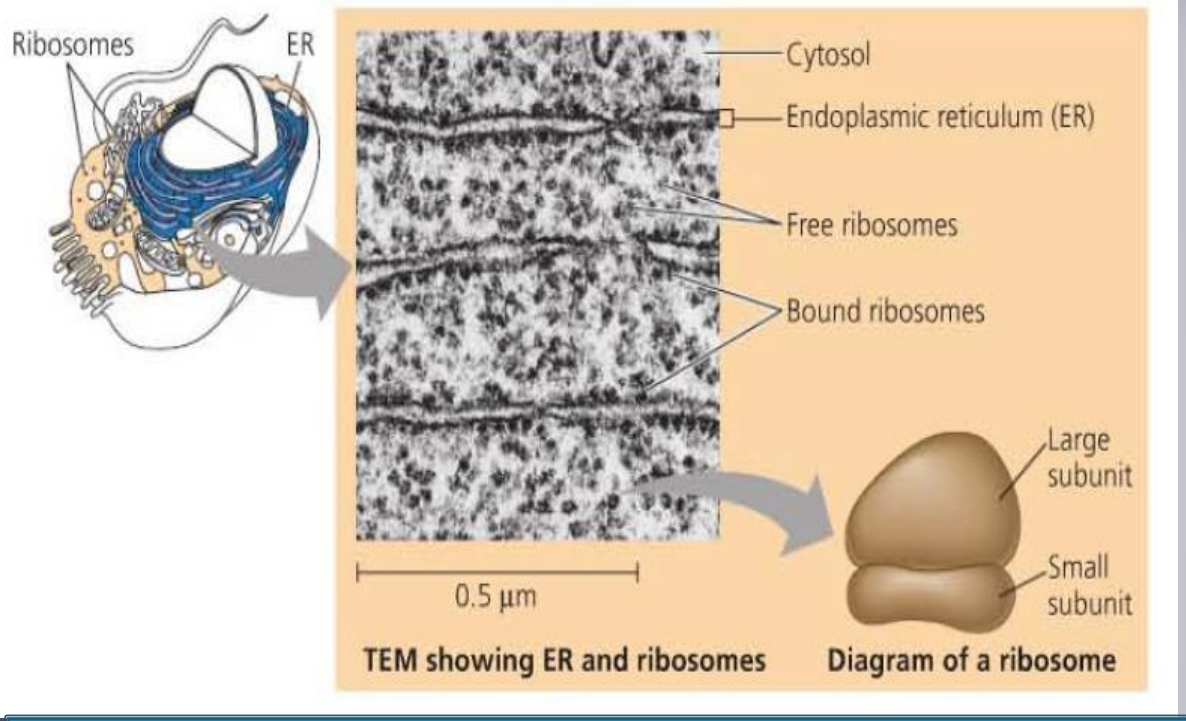




Mitokondria: batang2 kecil merah dlm sitoplasma sel tubulus ginjal (infranuklear tegak lurus membrana basalis)

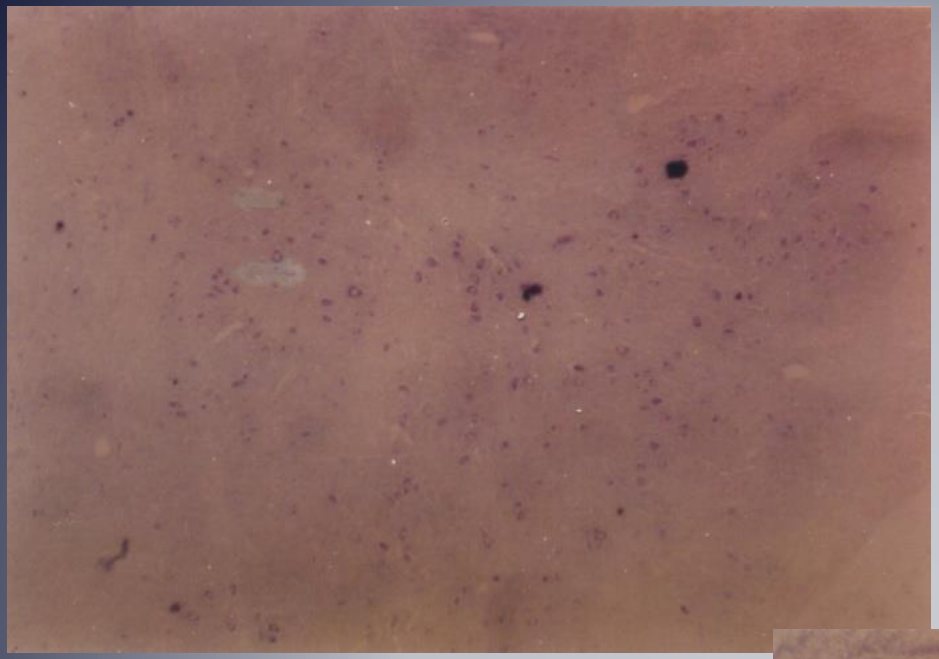


Ribosom

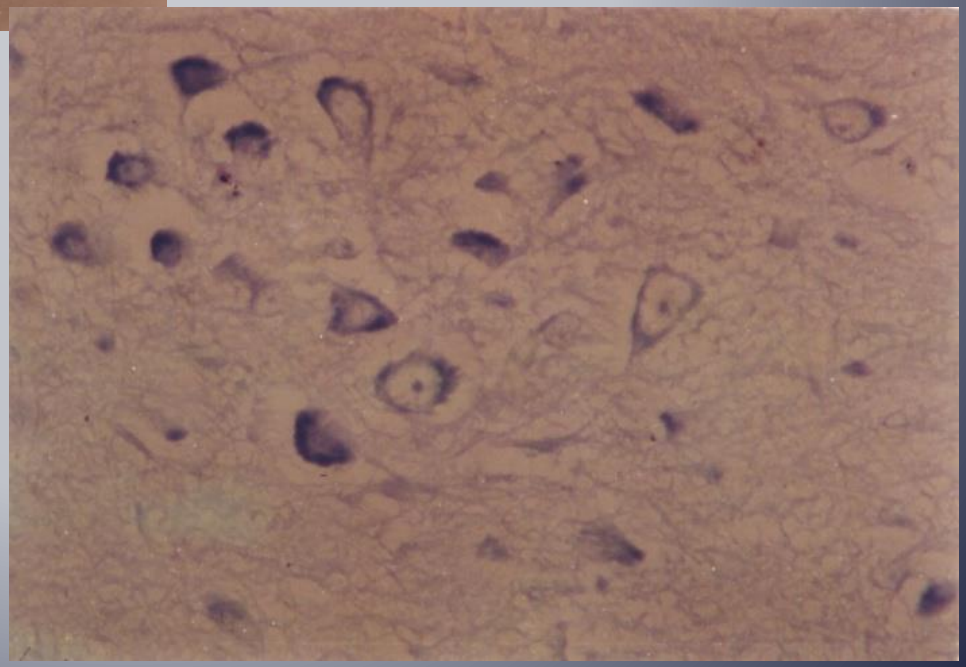


Organela yg mensitesis protein, 2 jenis:
a.ribosoma mitokondria,
b.ribosoma sitoplasmik (ergantoplasma pd sel glndula, Nissel bodies (sel neuron)
-Struktur: 2 subunit

Lokasi & fungsi: ribosoma sitoplasmik 2 bentuk→
-1. ribosoma bebas : individul tersebar di sitoplasma
-2. poliribosoma/polisoma: kel.ribosom di sepanjang benang mRNA → tersebar di sitoplasma (sintesis protein & enzim utk pengg.seluler) & menempel pd RE (sintesis protein utk disekresikan)

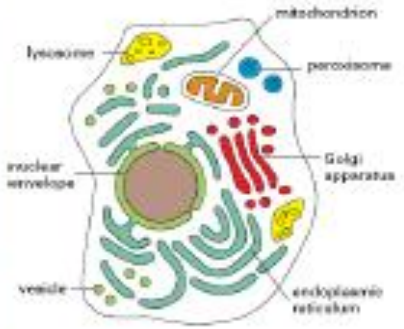


Nissel bodies (ribosoma sitoplasmik) : Bercak2 biru pd sitoplasma sel neuron



Retikulum Endoplasma

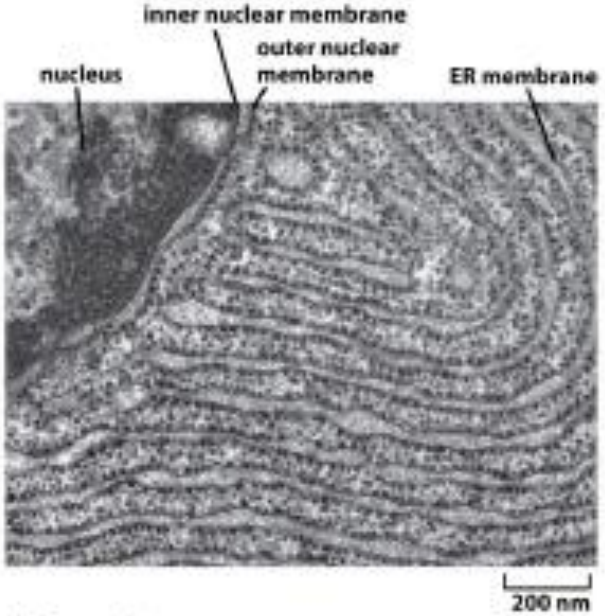
the production centers or factories of the cells



Endoplasmic Reticulum (ER):
the production centers or factories of the cells

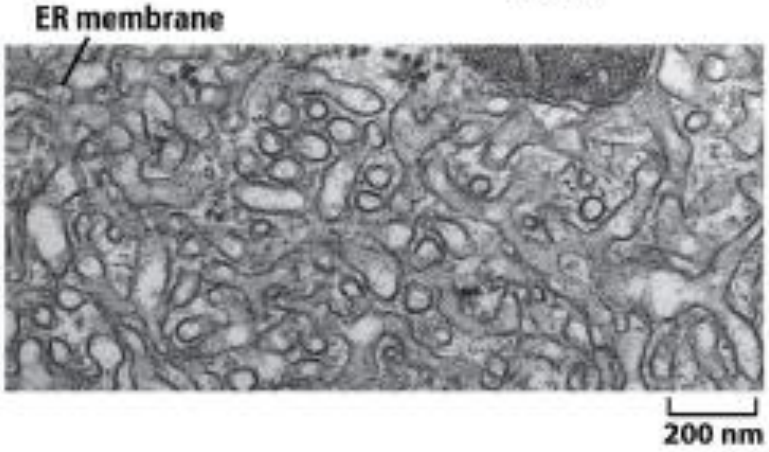
Rough ER

- has many ribosomes attached in their membrane
- transports newly formed protein to Golgi apparatus
- inside the lumen of Rough ER, proteins can be chemically modified

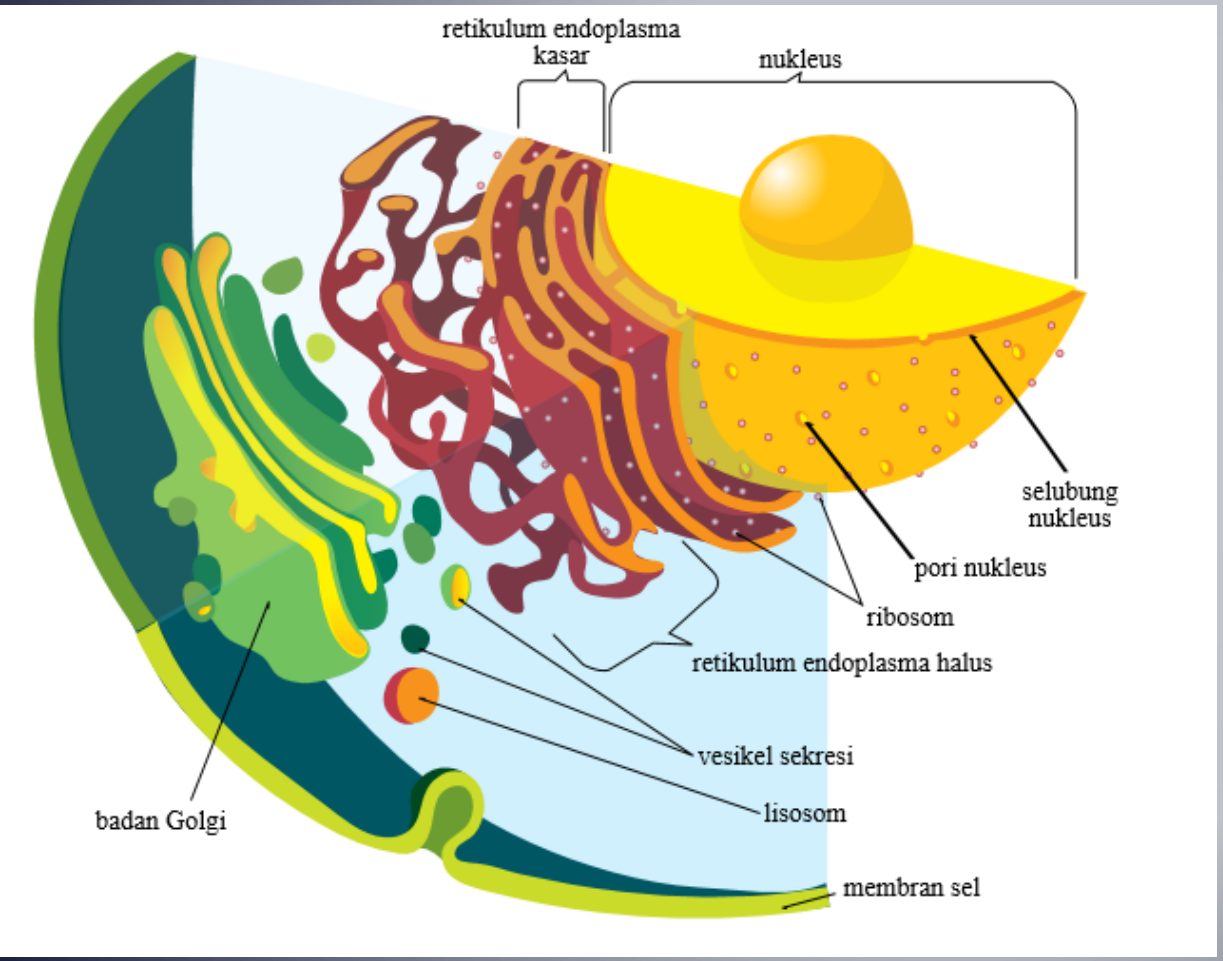


Smooth ER

- is the site of detoxification of chemically modifying small molecules (drugs and pesticides)
- the site for the hydrolysis of glycogen in animal cells
- the site for the synthesis of lipids and steroids



Retikulum Endoplasmik dalam Sistem Endomembran



Kompleks organela→ sintesis, pengemasan, pemrosesan berbagai substansi sel

Struktur & Fungsi:

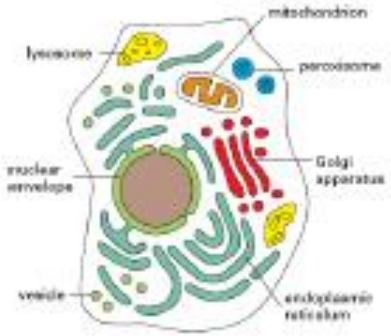
a. RE Kasar: pararel, memanjang, sel mensitesis protein dengan ribosom. Fungsi mensitesis protein yg disekresi exp sel asinus pankreas,sel plasma

b. RE halus : tanpa ribosom. Fungsi metabolisme lemak, sintesis hormon steroid,pemecahan glikogen & detoksifikasi

Apparatus Golgi

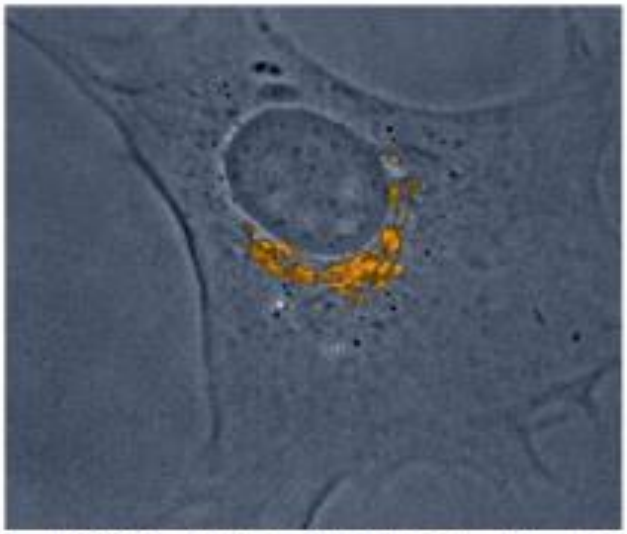
the packaging facilities of cell products

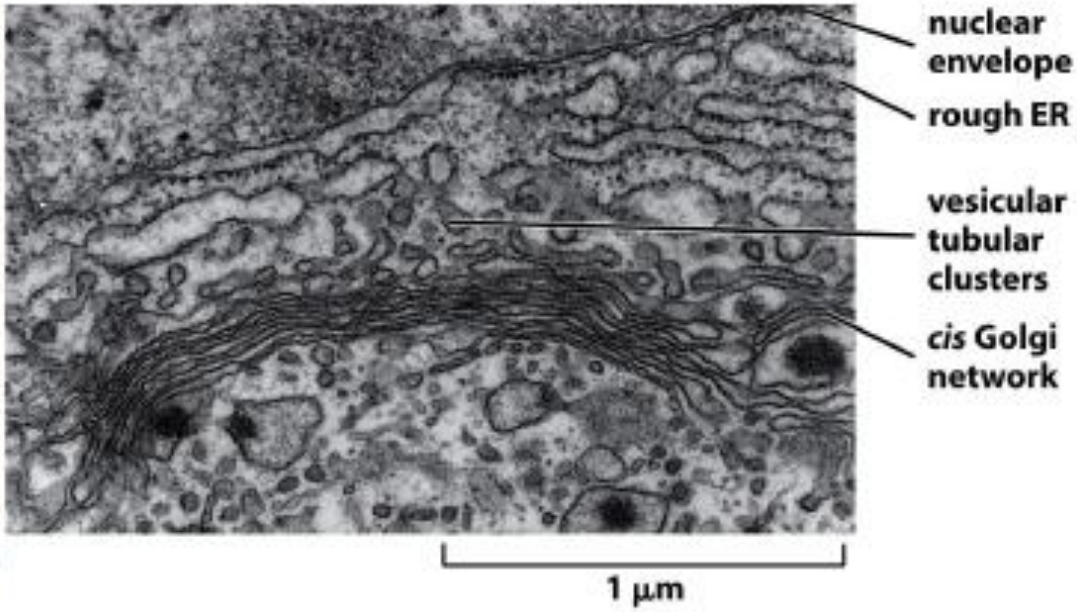
http://www.vitlfreight.com/services.html



Golgi Apparatus:
the packaging facilities of cell products

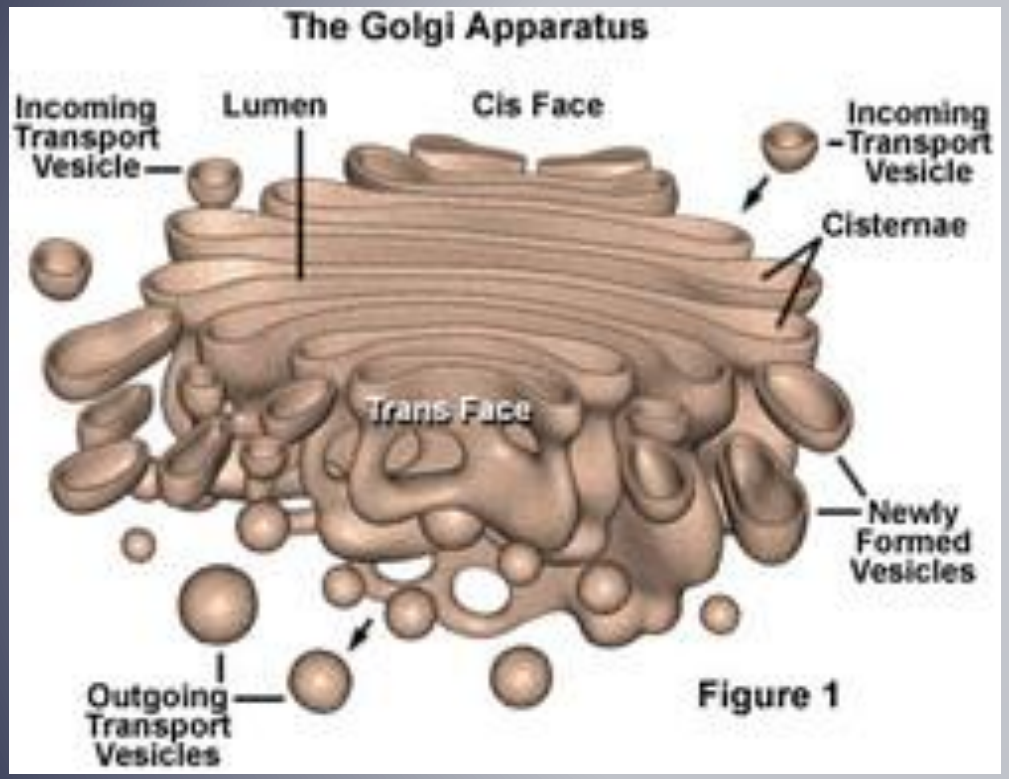
- **Golgi apparatus**
  - receives proteins from the ER and may further modify them
  - concentrates, packages, and sorts proteins before they are sent to their cellular or extracellular destinations





13-05 and 13-06 *Molecular Biology of the Cell* (© Garland Science 2008)

Kompleks Golgi/ Aparat Golgi/ Apparatus Reticulatus Internus



Organela bermembran terlibat terutama proses sekresi

Struktur:

-Sisterna (pipih, melengkung, terdiri 3-10)

-Vesikel perifer (kecil-kecil jumlah banyak)

-Beberapa kondensasi vakuola besar

Fungsi:

-Sintesis polisakarida

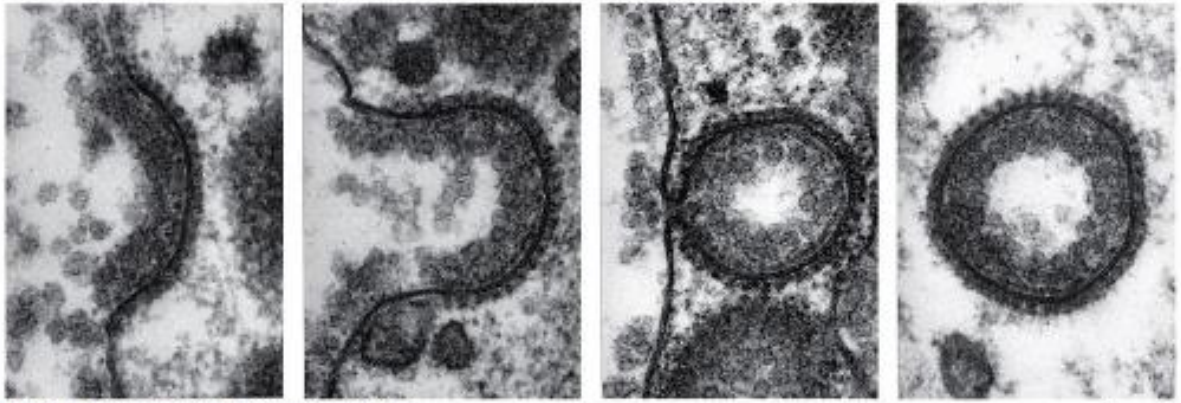
-Modifikasi produk sekretorik

-Mengemas produk sekretorik

-Mengentalkan & menyimpan produk sekretorik

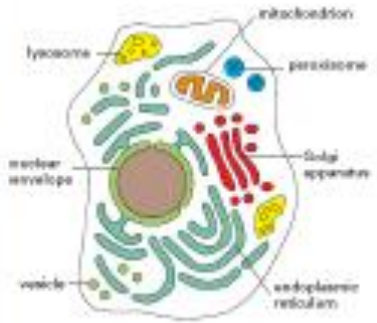
Granula atau Vesikel Sekretorik

Vesicles: package of substance that can be delivered from one compartment to other compartment inside a cell



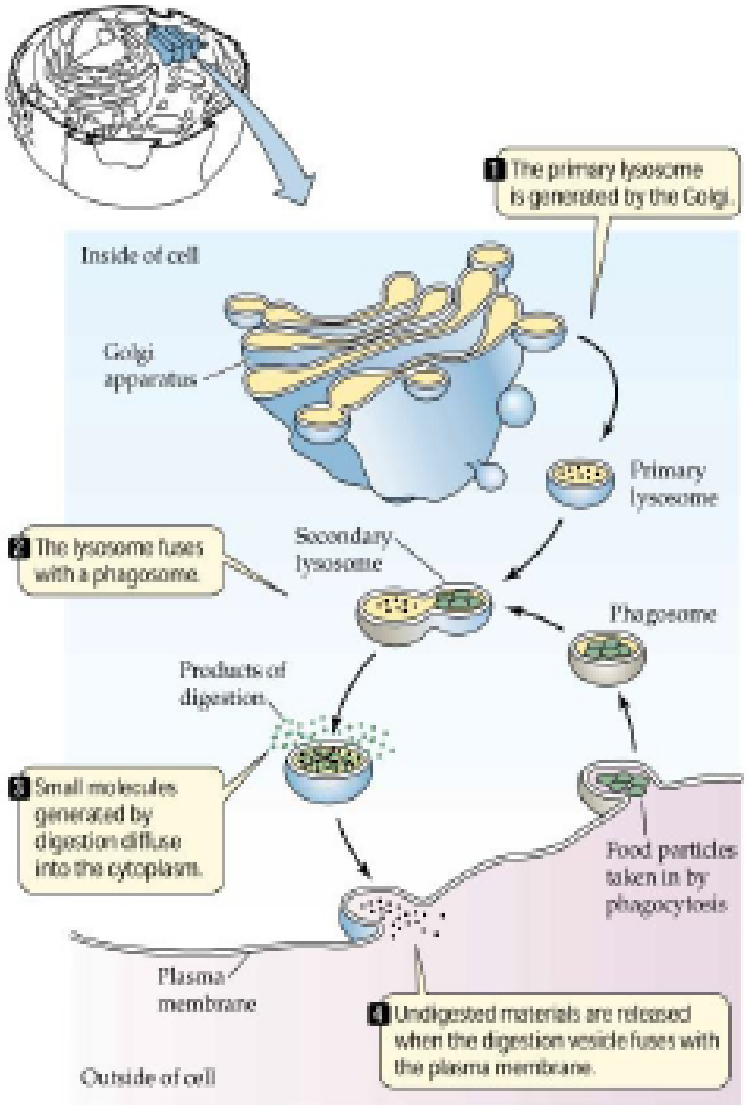
-2 *Molecular Biology of the Cell* (© Garland Science 2008)

Lysosomes the digestion center of the cells



http://blog.sustainablog.org/2008/11/city-to-pipe-biogas-from-farms-to-power-recycling-plant/

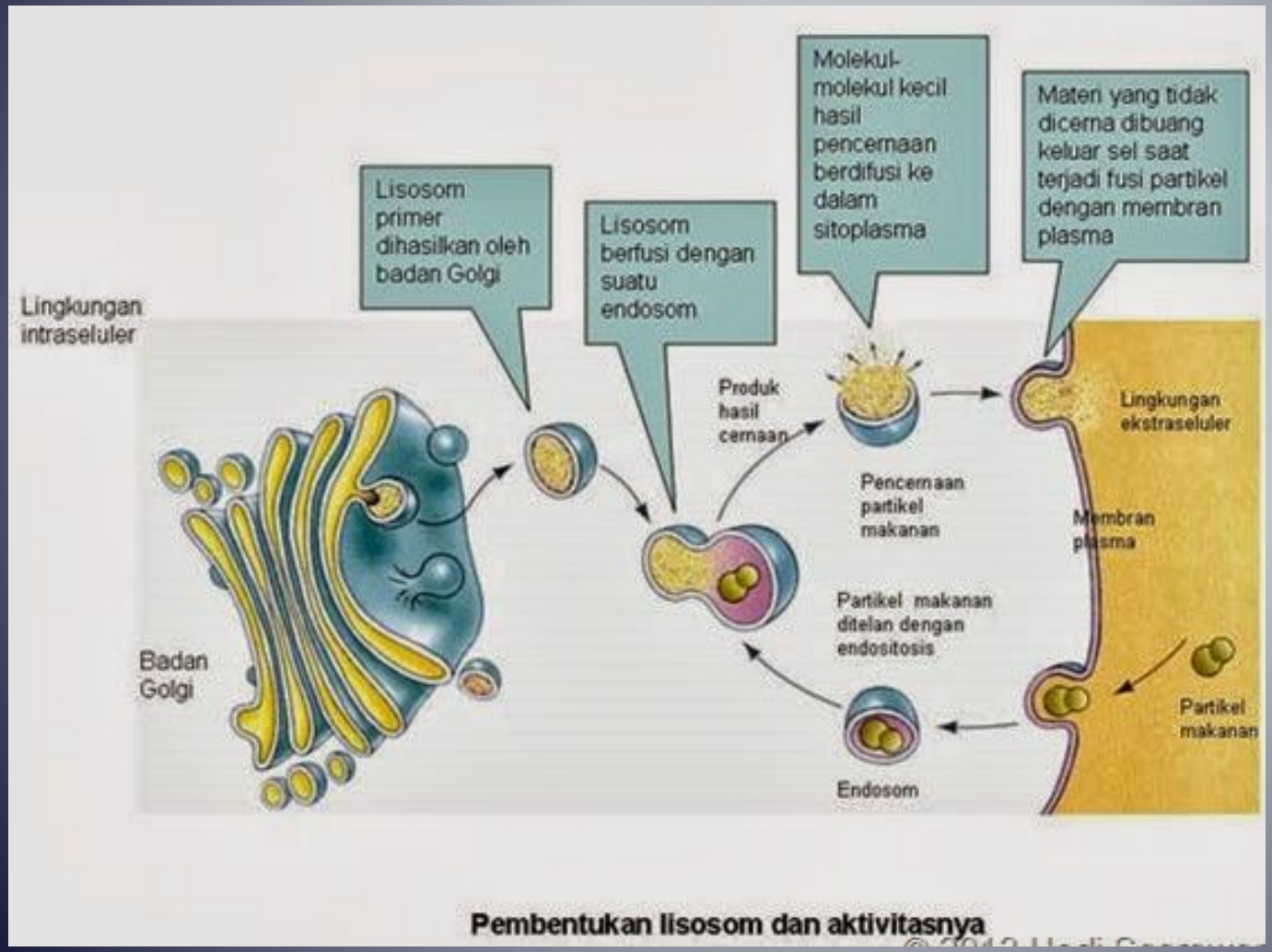
Lysosomes the digestion center of the cells



- are sites for the breakdown of food and foreign objects taken up by the cell by phagocytosis

- are sites where the cell digests its own material (autophagy)

Lisosom



Pembentukan lisosom dan aktivitasnya

Vesikel bermembran berisi > 50 enzim bersifat asam

Jenis:

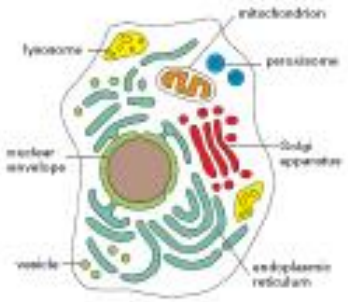
-lisosom primer

-Lisosom sekunder

-Residual bodies

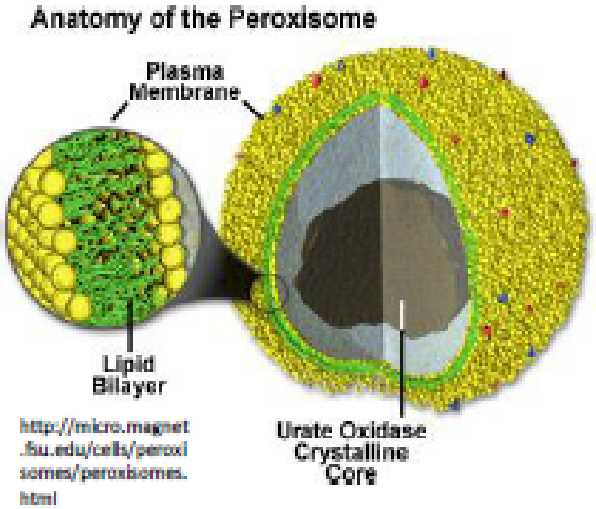
Peroxisomes

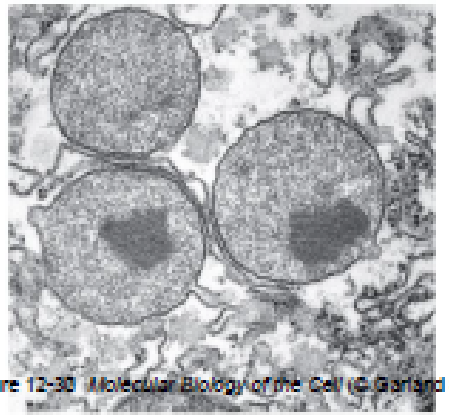
spherical organelles for minor digestion & detoxification



Peroksisom

spherical organelles for minor digestion & detoxification



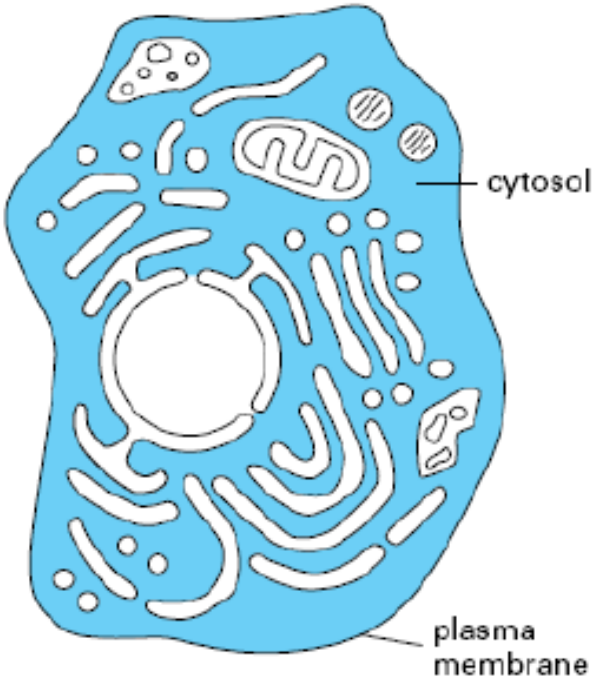


gure 12-30 Molecular Biology of the Cell (© Garland Science 2008)

- Function to **rid the cell of toxic substances**, and in particular, hydrogen peroxide (a common byproduct of cellular metabolism)
- Some types of peroxisomes, such as those in liver cells, **detoxify alcohol and other harmful compounds** by transferring hydrogen from the poisons to molecules of oxygen (a process termed **oxidation**)
- Others are more important for their ability to **initiate the production of phospholipids**, which are typically used in the formation of membranes

Sitoskeleton

Cytosol is not a liquid compartment but more resemble gel-like structure

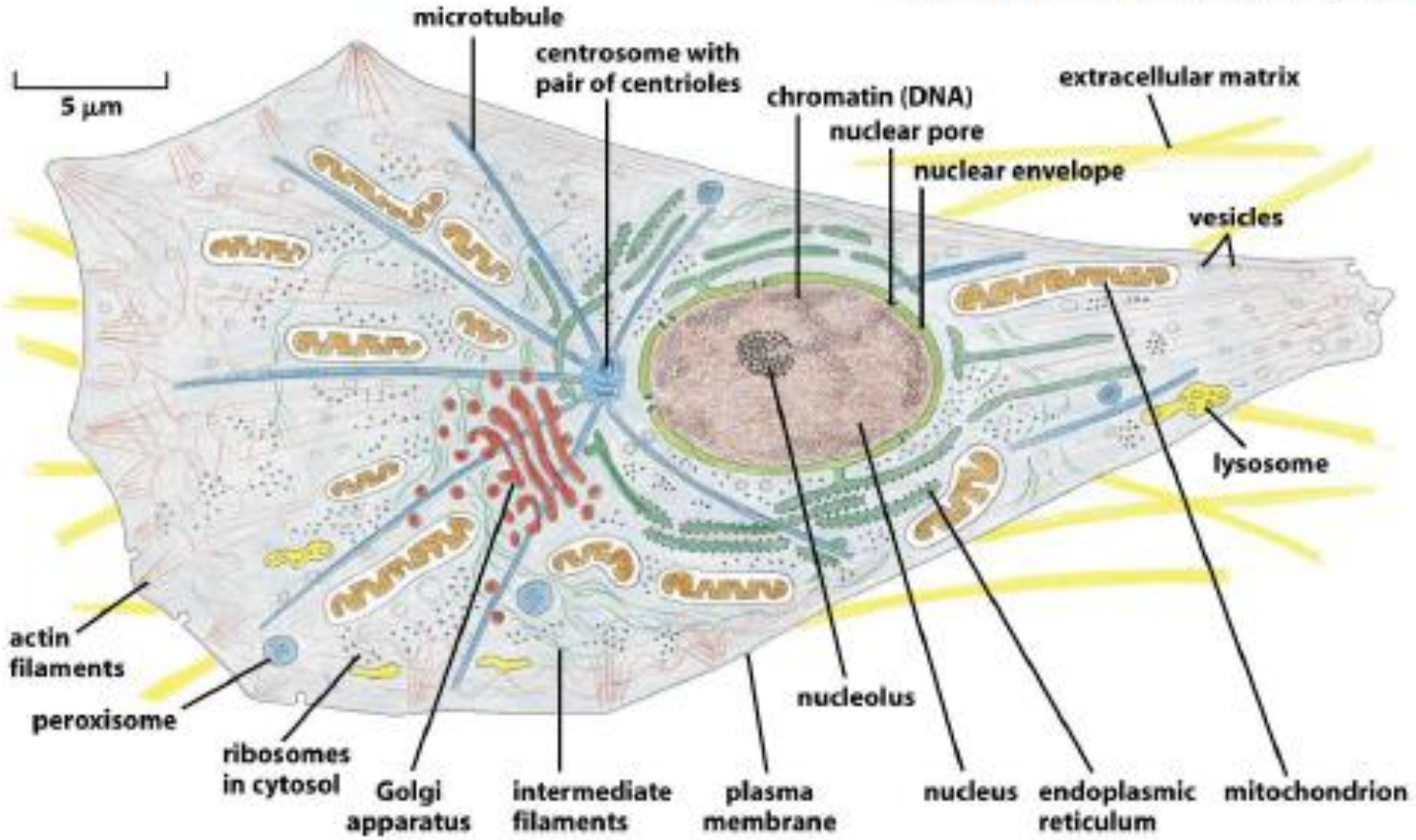


Many filaments can be found in the cytosol

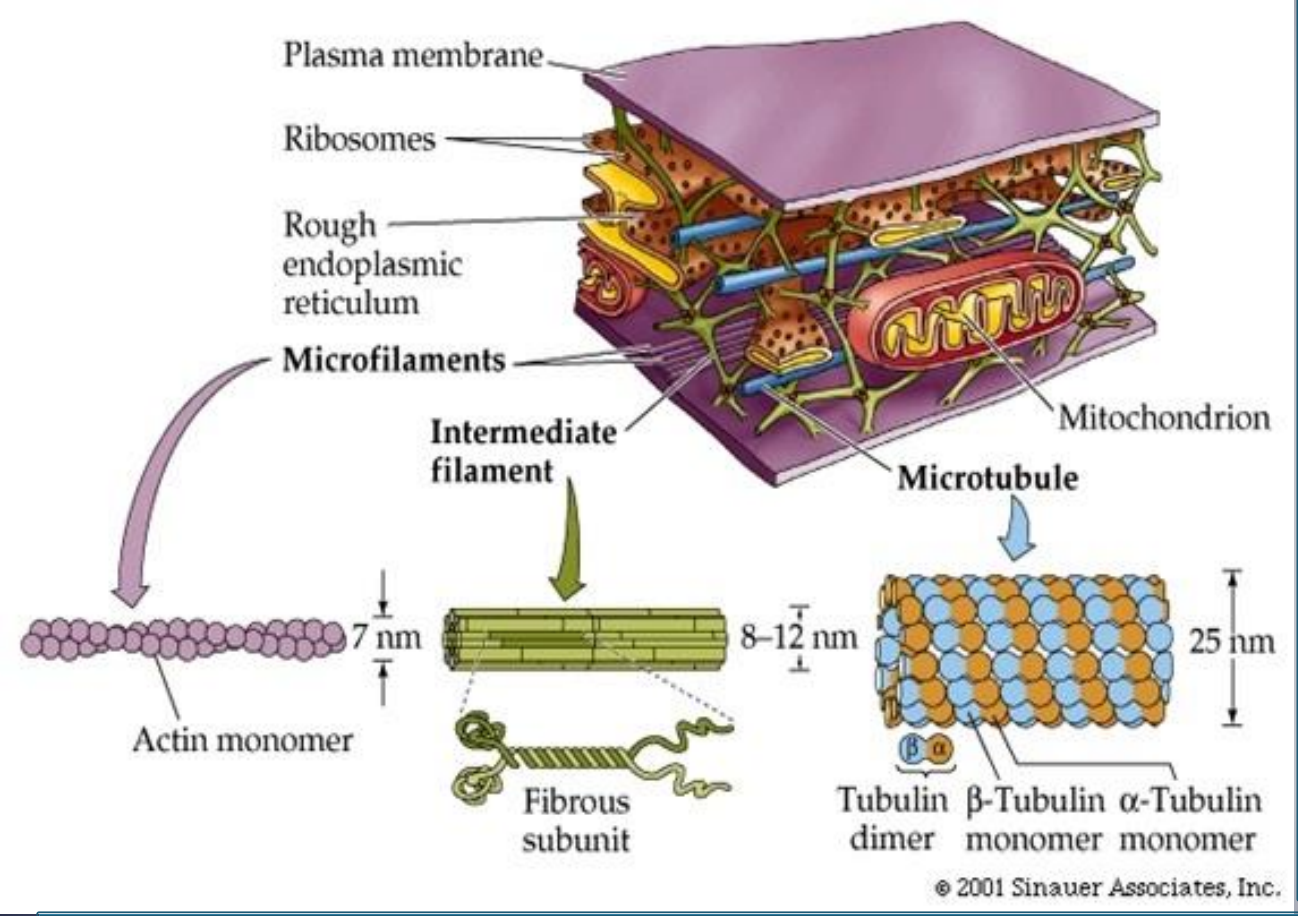
Microtubule, intermediate filament, microfilament are the main cytoskeleton of the cell

olecular Biology of the Cell, Fifth Edition (© Garland Science 2008)

What is the function of cytoskeleton?



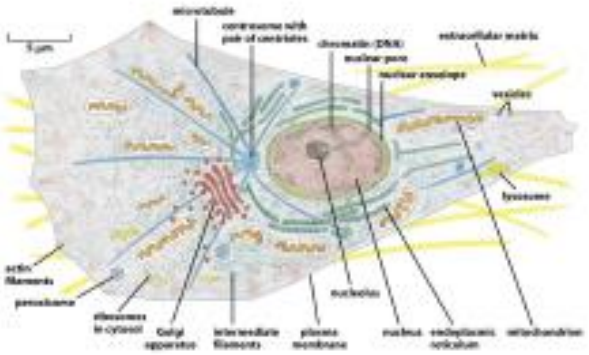
Sitoskeleton



1.Mikrotubulin: subunit tubulin heterodimer→@ oleh a-tubulin, memelihara bentuk sel, berada di seluruh sitoplasma berkelompok baik di sentriola, cilia, flagela, basal bodies & benang mitotik
2. Mikrofilamen: paling tipis, tersusun 1 jenis protein aktin, bersifat kontraktil utk berkontraksi hrs interaksi dgn myosin, di dlm sel bukan otot tersebar tdk teratur di sitoplasma

3. Filamen Intermedia: ukuran diataranya, tersusun dari protein yg struktural terkait dgn lamins nukleus & berbeda2 tergantung jenis sel exp sel epitelial (sitokeratin), sel mesenkima (vimentin), sel otot (desmin), sel neuron (neurofilament)

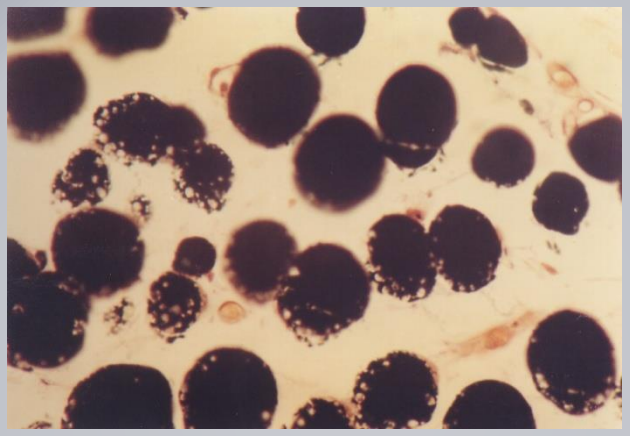
Microtubule is a cellular highway



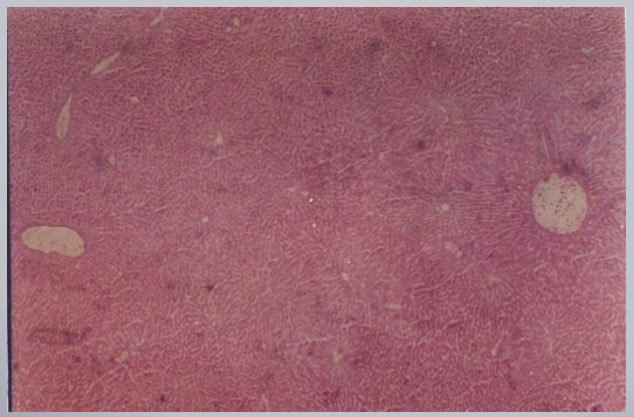
http://sf.streetsblog.org/2010/02/19/hairball-study-coughs-up-ideas-memories/

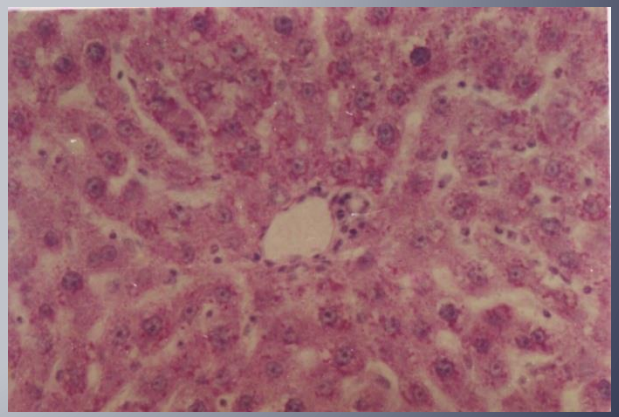
Inklusion Sitoplasmik

- Tumpukan metabolit/zat lain→komponen sementara sitoplasma
- Tidak bergerak
- Tidak memiliki/hanya sedikit aktifitas metabolik
- Bukan organel
- Exp Droplet lemak, granula glikogen, melanin, granula lipofusin



Tetes lemank : bulatan lemak dalam vakuola lemak, nukleus terpulas hitam





Granulum glikogen: butir2 merah magenta tersebar dlm sitoplasma hepatocytus (poligonal, berderet tersusun radier vena centralis

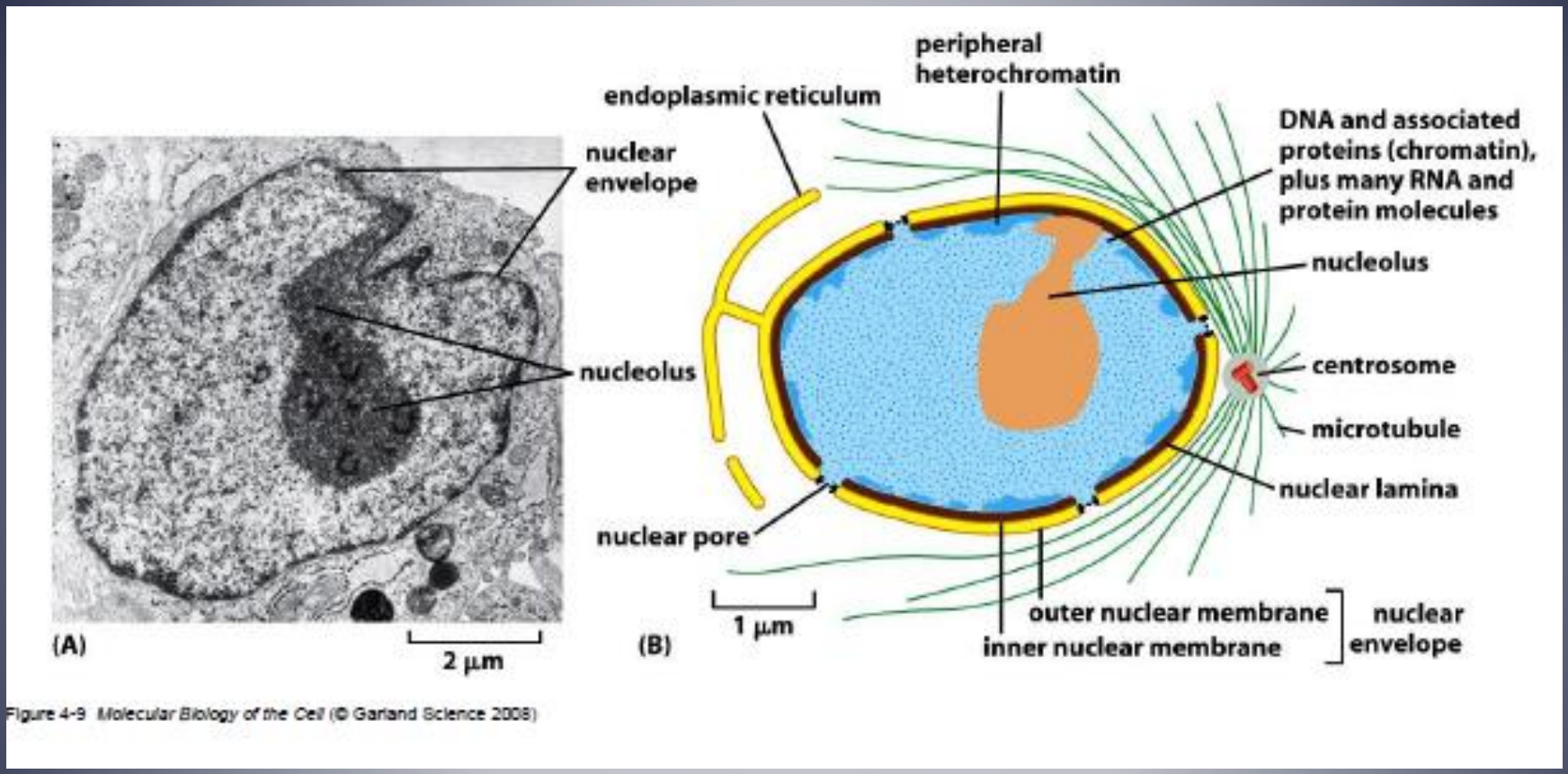


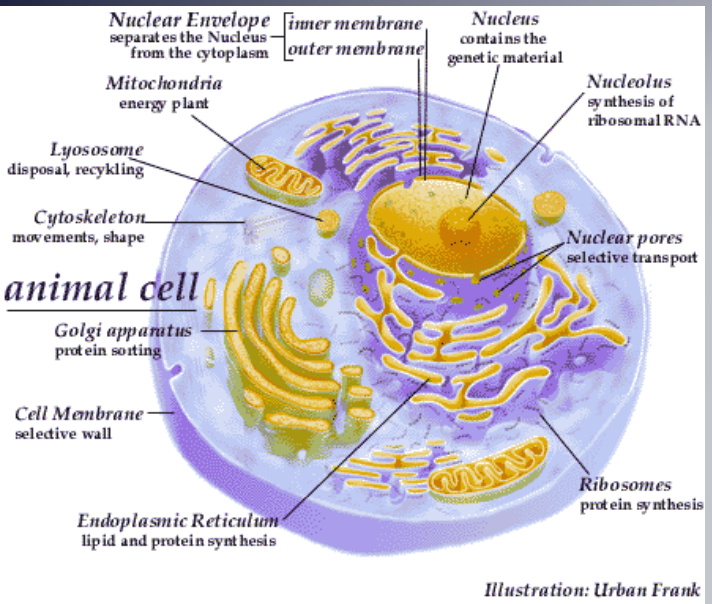
Figure 4-9 *Molecular Biology of the Cell* (© Garland Science 2008)

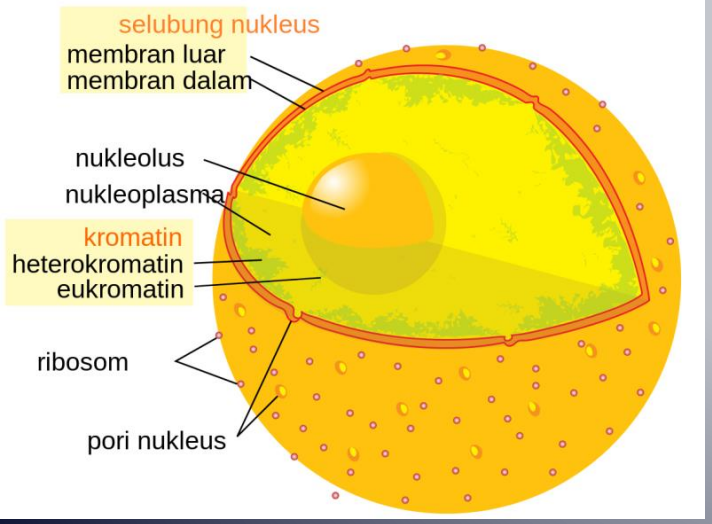
Fungsi Nukleus:

1. Pengaturan Sel →menyimpan material genetik , mengarahkan semua aktifitas sel, mengatur struktur sel
2. Produksi→ memproduksi subunit ribosom di nuklelolus dan mengirimnya ke sitoplasma utk dirakit menjadi ribosom

The genetic information stored in DNA is an archive of instructions ("recipes" or "documents") that cells use to produce proteins

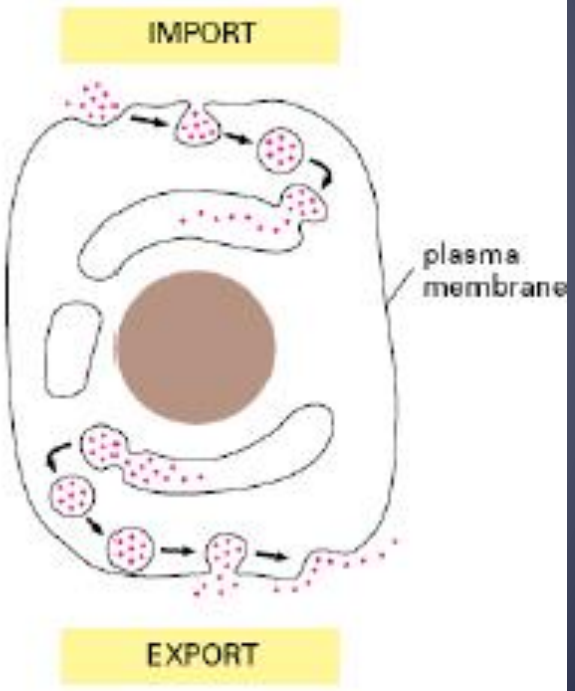
NUKLEUS





1. Selubung nukleus: membran ganda memisahkan nukleus dari sitoplasma, perluasan RE bergranula, Sebelah dalam dilapisi lamina fibrosa (lamins), berlubang2→porus nuklear terikat oleg 8-globuler subunit (protein anular)
2. Kromatin: berisi DNA (sangat basofil), perbutir (nukleosoma), 2 jenis (heterokromatin & eukromatin)
3. Kromosom: kondensasi kromatin (jelas pd mitosis), manusia 46 kromosom somatik (22 pasang) & sepasang kromosom seks (XY)
4. Nukleolus: 1 buah, sangat basofil, heterokromatin (sejumlah kecil) menempel
5. Nukleoplasma: matriks nukleus→ struktur fibriler nukleoskeletal (komponen intranuklear terbenam → mengikat reseptor hormon & memperbaharui sintesis DNA (4 Fase) , tersusun oleh prot.enzimatik/nonenzimatik, metabolit, ion & air

Cell as a tiny independent island



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- Histologi dasar Junquera, Teks dan Atlas, Edisi 12.EGC.Jakarta.Mustarichie,R.,Musfiroh,I.,and Levita,J.2011