O’ZBEKISTON RESPUBLIKASI OLIY VA O’RTA MAXSUS TA’LIM VAZIRLIGI

AL-XORAZMIY NOMLI URGANCH DAVLAT UNIVERSITETI

TABIIY FANLAR FAKULTETI

“ BIOLOGIYA” KAFEDRASI

5140100 – Biologiya yo’nalishi talabalari uchun

«SITOLOGIYA»

fanidan

o’quv uslubiy majmua

Tuzuvchi: **dots. Babadjanova S.X.**
o’qit. Do’schanov J.

Urganch - 2016

MUNDARIJA

SILLABUS

«SITOLOGIYA»
fanining
2015/2016 o'quv yili uchun mo'ljallangan
SILLABUSI

Fanning qisqacha tavsifi					
OTMning nomi va joylashgan manzili:	UrDU Urganch shaxri			X.Olimjon 14	
Kafedra:	Biologiya			Tabiiy fanlar fakulteti tarkibida	
Ta'lim sohasi va yo'nalishi:	**110000 - Pedagogika**		**5140100 Biologiya (turlar bo`yicha)**		
Fanni (kursni) olib boradigan o'qituvchi to'g'risida ma'lumot:	Babadjanova Sayyora Xushnutovna		**e-mail:**	Sayyora1571@mail.ru	
Dars vaqti va joyi:	2-bino 211- auditoriya		**Kursning davomiyligi:**	02.09.2015-29.02.2016	
Individual grafik asosida ishlash vaqti:	seshanba, payshanba va shanba kunlari 14.00 dan 17.00 gacha				
Fanga ajratilgan soatlar	**Auditoriya soatlari**			**Mustaqil ta'lim:**	50
	Ma'ruza:	30	**Amaliy mashg'ulot**	42	
Fanning boshqa fanlar bilan bog'liqligi (prerekvizitlari):	"Gistologiyai", "Zoologiya", "Molekulyar biologiya", "Botanika", "Odam va xayvonlar fiziologiyasi", "Osimliklar fiziologiyasii", "Genetika"				
Fanning mazmuni					
Fanning dolzarbligi va qisqacha mazmuni:	**Fanni o'qitishdan maqsad** – Fanni o'qitishdan maqsad- talabalarga xar qanday tirik organizmning asosiy tarkibiy qismi xujayradan iboratligini uning shakllari, rivojlanish taraqqiyoti, solishtrma tsitalagik yo'nalishlar, xujayra organoidlarining shakillanishi o'sishi, vazifalari o'zaro aloqadorligio'tkazuvchanligi tasirchanligi, bo'linish jarayonida genetik axborot saqlanishi, taqsimlanishi, genetik xaritalash qonuniyatlari, turli omillarning tasiri natijasida patologik nekroz, apoptoz xodisalari xaqida sitalogik bilim, ko'nikma va malakani shakllantirishdir. **Fanning vazifasi** - talabalarda sitalogiyaning ilmiy nazariy asoslarini berish bilan bir qatorda uning zamonaviy tadqiqot metodlarining, mikro texnikadan to'g'ri foydalanishni mikropriparatlar tayyorlashni, olingan natijalarni taxlil qilishni o'rgatishdan iborat.				
Talabalar uchun talablar	- o'qituvchiga va guruhdoshlarga nisbatan hurmat bilan munosabatda bo'lish; - universitet ichki tartib - intizom qoidalariga rioya qilish; - uyali telefonni dars davomida o'chirish; - darsda birovning gapini bo'lmaslik; - darsda gapirayotganda aniqlikka va cheklilikka, ommaviylikka rioya qilish; - berilgan uy vazifasi va mustaqil ish topshiriqlarini o'z vaqtida va sifatli bajarish; - ko'chirmachilik (plagiat) qat'iyan man etiladi;				

	- darslarga qatnashish majburiy hisoblanadi, dars qoldirilgan holatda qoldirilgan darslar qayta o'zlashtirilishi shart; - darslarga oldindan tayyorlanib kelish va faol ishtirok etish;
Elektron pochta orqali munosabatlar tartibi	Professor-o'qituvchi va talaba o'rtasidagi aloqa elektron pochta orqali ham amalga oshirilishi mumkin, elektron pochtani ochish vaqti soat 16.00 dan 19.00 gacha

Fan mavzulari va unga ajratilgan saotlar taqsimoti:

№	Mavzular	Ma'ruza	Amaliy mashg'ulot	Mustaqil ish
1.	Sitologiya fanining mazmuni, maqsadi va vazifalari.	2	2	2
2.	Hujayra va uning tuzilishi	2	4	2
3.	Sitoplazma va xujayraning vakuolyar tizimi	2	2	2
4.	Endoplazmatik retikulum	2	2	4
5.	Goldji apparati	2	2	4
6.	Lizosomalar.	2	2	4
7.	Sitoplazmaning ikki membranali organodlari	2	4	4
8.	Membranaga ega bo`lmagan organellalar	2	4	4
9.	Hujayra yadrosi.	2	4	4
10.	Xujayralar ning xarakat-lanishi, ta'sir-lanishi, shikastlanishi, qo'zgalishi, o'tkazuvchanligi, sekretorlik faoliyati.	2	2	2
11.	Xujayralar ning bo'linishi	2	4	4
12.	Xromasomalarning tuzulishi va vazifalari.	2	2	4
13.	Irsiyatning sitologik asoslari	2	2	4
14	Xujayraning qayta tiklanishi va uning davomiyligi	2	2	2
15	Nekroz va apoptoz .		4	4

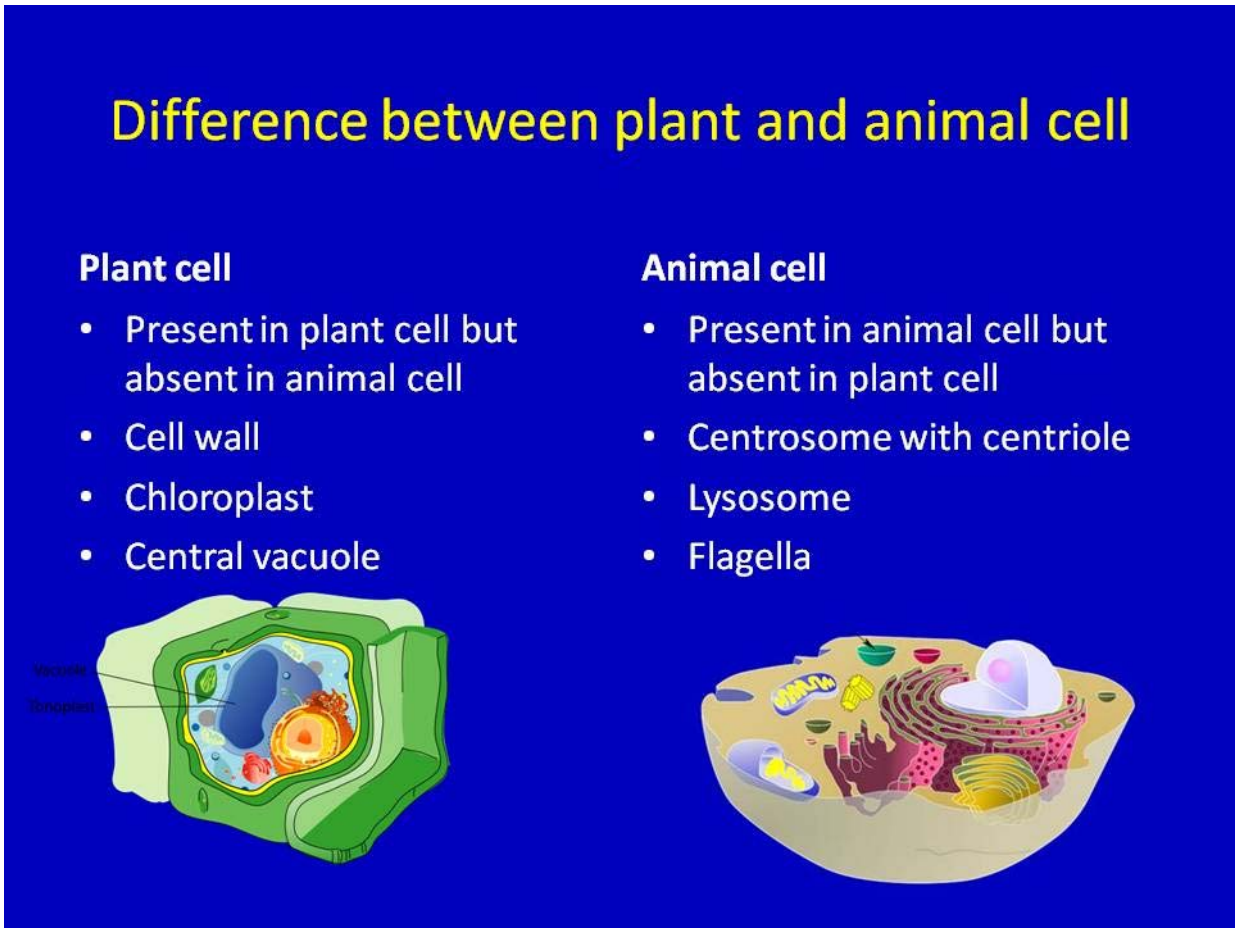
Jami	**30**	**42**	**50**

№	Amaliy mashg'ulotlari mavzusi	Ajratilgan soat
1.	Mikroskop tuzulishi, uning xillari va u bilan ishlash qoidalari.	2
2.	Hujayralarning shakli va o'lchami.	2
3.	Prokariot xujayralarning xilma xilligi	2
4.	Eukariot xujayralarning xilma xilligi	2
5.	Xujfyraning tashqi apparati. Glikokolikslar, kiprikchalar, mikrotukchalar.	2
6.	Xujayraning vakuolyar tizimi.	2
7.	Endoplazmatik to'r,	2
8.	Peroksisoma, sferasoma.	2
9.	Goldji apparati.	2
10.	Lizosomalar.	2
11.	Ikki membranali yarim avtonom organoidlari.	2
12.	Membranasiz organoidlar.	2
13.	Yadro kimyoviy tarkibi va hujayra hayotidagi ahamiyati.	2
14.	Xromosoma morfologiyasi, xromosoma tiplari.	2
15.	Xromasomasomaning genetik va kimyoviy tarkibi	2
16.	Kariotip	2
17.	Mitoz. Mitoz fazalari.	2
18.	Meyoz.	2
19.	Sekret moddalarining xujayradan ajralishi	2
20.	Endoreproduktsiya.	2
21.	Nekroz. Apoptoz.	2
	Jami	**42**

Asosiy adabiyotlar:	1.СвенсонК., УэбстерП. Клетка. М.: Мир, 1980.303с. 2.Заварзин А.А., Харазова А.А. Основы общей цитологии. Л. изд. ЛГУ, 1982. 240с. 3.Ченцов Ю.С. Цитология. М.: изд. МГУ, 1984. 352с.

	4.Атабекова А.И.,Устинова Е.И. Цитология растений,из-во колос, Москва 1987г.
Qo'shimcha adabiyotlar:	Зенгбуш П. Молекулярная и клеточная биология. М.: Мир,1982. 215с. 6.Бойқобилов Т.Б., Икромов Т.Х. Цитология. Тошкент, «Ўқитувчи», 1980. 195с. 7.Фрей-Вислинг А. Сравнительная органеллография цитоплазмы. М., Мир, 1986. 144с. 8.Соттибоев И., Қўчқоров Қ. Ўсимлик ҳужайраси. Тошкент, «Ўқитувчи», 1991. 121с. 9.Г.Л.Билич. Биология, Цитология, гистология, Анатомия человека. Санкт-Петербург. Издательство «Союз». 2001 г 444с. 10.Абдулов И.А.,Қодирова Н.З. "Цитология" фанидан ўқув-услубий мажмуа. Тошкент 2011й. 11.Babadjanova S.X. "Sitologiya" fanidan O'UM. Urganch 2015 y.
Chet el adabiyotlar.	1. Botany an introduction plant's biology. Jeans D. Maneth.

Cell: A Guided Tour



Biosferadagi hayot shakllari

- - O'simliklar
- - Hayvonlar
- -Mikroorganizmlar

Hujayra – asosi, hayotning struktura va funksional

Hujayra hayotning asosiy birligi
Hujayra hayotiy oragnizmlarning eng kichik birligi
Hujayra hayotning qurilish materiali
Hujayra hayotning tuzilish birligi
Hayotning hamma tuzilishi hujayradan tuzilgan
Hujayra hayotning funksional birligi

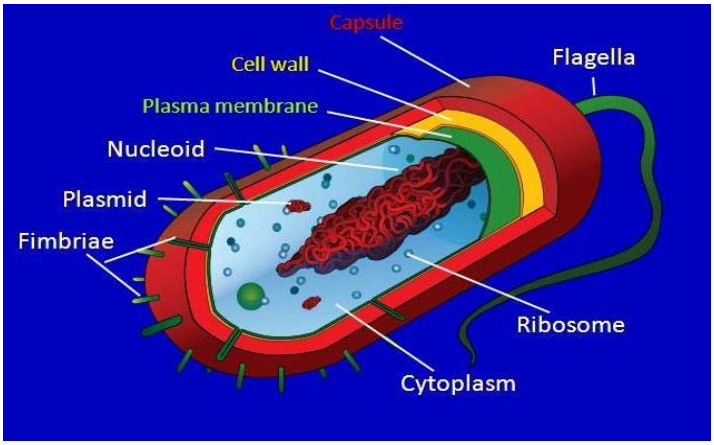
Hujayraning tuzilish asosi.

- Membrana chegarasi: Plazma membranasi
- Ichki muhit: Sitoplzma.
- Hayotning informatsiyasini saqlovchi molekula: DNK

Hujayra tuzilishi

Prokoryotlar
Prokaryotlar bakteriyalar, sianabakteriyalar va arhebakteriyalarni o'z ichiga oladi

Eukariotlar
Eukoryotlar bir hujayralilar, zamburuglar, o’simliklar va hayvonlar



Prokariot hujayra tuzilishi.

- Prakariotlarga oid organizmlarning sitaplazmasida alohida yadro bo’lmaydi.
- Sitaplazmasida bir yoki bir necha DNK yig’indisi bo’ladi bunga nukliotid yoki nulioplazma deyiladi.
- Xaqiqiy xromosamalar bo’lmaydi.
- Prakariotlar hujayrasida sitologik membranadan tashkil topgan mezasomalar bo’ladi.
- Prokariotalrga kiruvchi o’simliklarda hujayraning mitoz va miyozga bo’linishi aniqlanmagan . Ularda jinsiy jarayon uchramaydi. Ayrim vaqtlardagina konyugatsiyaa jarayoni kuzatiladi.

- **Eukariot hujayra tuzilishi.**

Eukariot hujayra kichik komponentlarga bo’linadi. Asosiy tuzilishi:

- Plazmatik membrana
- Yadro
- Sitoplazma

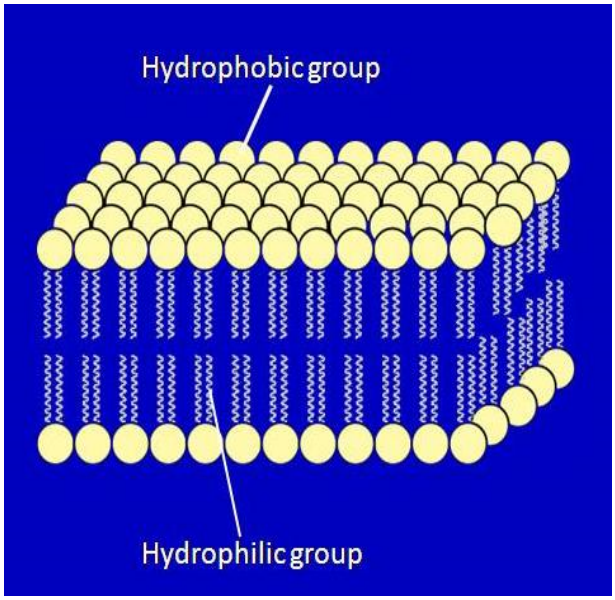
PLAZMATIK MEMBRANA (PLAZMOLEMMA.)

Plazmolemma suvni boshqa birikmalarga nisbatan oson, asosan diffuz holda o’tkazadi. Yirik molekulalar plazmolemmada o’ta olmaydi, bu uning to’siq vazifasidir. Kichik molekulalar va ionlar plazmolemma orqali gialoplazmaga turli tezlikda o’tadi. Moddalarni diffuz holda o’tishi cheklangan va kontsentratsiya farqiga teskari bo’lsa ham o’tkazish imkoniyatlari bor. Ayrim hollarda plazmolemma to’lqinsimon, ba'zan esa chuqur ko’plab buklamalarni ham hosil qiladi.. Plazmolemma o’zidan ion va molekulalarni sitoplazmaga yoki tashqi muhitga o’tkazishni boshqarishdan tashqari, o’simliklarda moddalarni hosil qilish vazifasini ham bajariladi.

Plazmatik membrana-tuzilishi

Plazmatik membrane trilaminar tuzilishga ega.Lipid qatlam va oqsillar asatsiyasidan tashkil topgan.

Plasma Membrane – Structure



Asosiy komponentlar lipidqatlam fosfolipidlar

Hujayraning po‘sti o‘z hayotida bir qancha o‘zgarishlarga uchraydi. Ba’zi bir o‘simliklarning hujayra po‘sti po’kaklanadi, ba’zi birlari shilimshiqlanadi. Agar hujayra po‘sti lignin deb ataladigan modda bo’lsa hujayra po‘sti yog‘ochlanadi. Lignin $C_{57}H_{60}O_{10}$. Lignin C,H,O dan tashkil topgan. Yog‘ochlangan hujayra o‘zidan suvni va havoni yaxshi o‘tkazmaydi. Shuning uchun ham yog‘ochlangan hujayra o‘lik bo‘ladi. O‘tkazuvchi to‘qimaning suv naylari, traxeidlari, mexanik to‘qima hujayralari lignin moddasi. Suv naylari orqali suv erigan xoldagi mineral moddalar pastdan yuqoriga, ya’ni ildizdan poyaga, poya orqali bargga boradi, mexanik to‘qimalar esa o‘simlikka qattiqlik berib turadi.

Yadro

Yadroning tuzilishidagi umumiylik barcha hujayralar, o’simlik va hayvon hujayralari uchun ham bir xil. Eukariot tuzilishli hujayralarning yadrosi ikkita elementar membrana bilan o’ralib yadro po’stini hosil qiladi. Unda elektron mikroskop orqali ko’rsa bo’ladigan diametri 30 dan 100 nm gacha bo’lgan juda ko’p tirqishchalar bor.

Yadroda maxsus bo’yoq bilan bo’yalganidan keyin ingichka ip *xromatin* va to’plam *nukleoplazma* boshqacha aytganda yadroning asosiy moddasi ko’rish mumkin. Xromatin ko’p miqdordagi maxsus oqsil-gistonlar bilan bog’langan DNK dan tashkil topgan. Hujayra bo’linayotgan vaqtda xromatin tig’izlanib pirovard natijada *xromosomalarga* aylanadi. Bo’linayotgan hujayrada ya’ni uni interfaza davrida yadroning xromosomalari (xromatin) yadro po’stini biror yoki bir necha joyiga yopishib olgan bo’ladi

Har bir yadroda bitta yoki bir nechta yadrocha bo’lib uni bo’linmayotgan yadroda ham ko’rish mumkin.

Yadrocha yumaloq anchagina tig’iz diametri ko’pincha 1-3 mkm keladi. U va undagi xromatin membrana bilan o’ralmagan.

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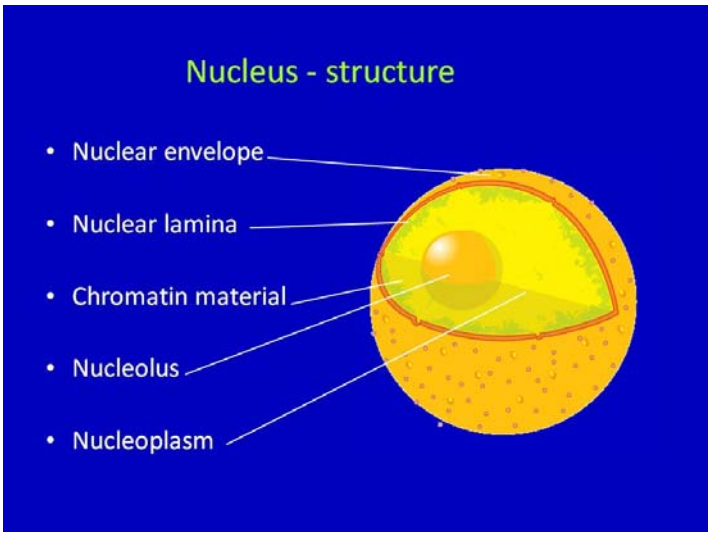
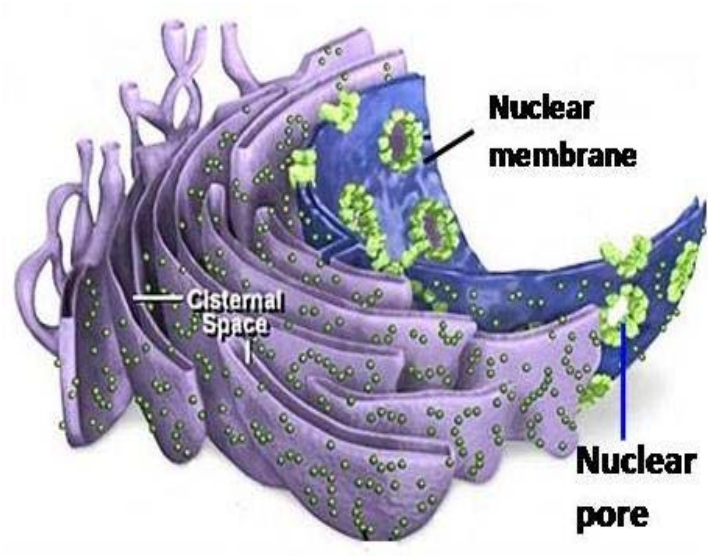
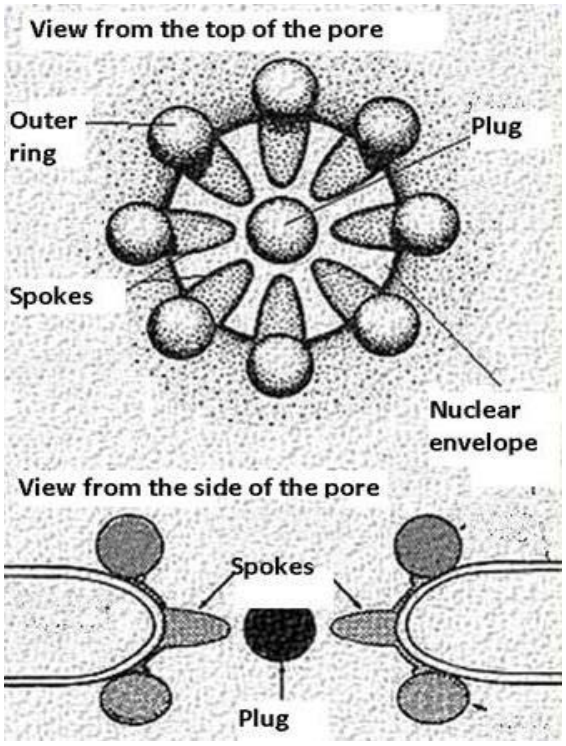


Yadro po’sti qalinligi 40-60 nm keladi, shu tufayli uni yorug’likdan foydalanib ishlatiladigan mikroskoplar orqali ko’rib bo’lmaydi. Bu mikroskopda ko’rinadigan qismi, yadro va gialoplazmani chegaralab turadigan qismi po’st deb hisoblanadi. Yadroning po’stini ko’ndalang kesmasida qo’sh membrananing oralig’i turlicha qalinlikda bo’lgan perinuklear bo’shliqdan iborat.

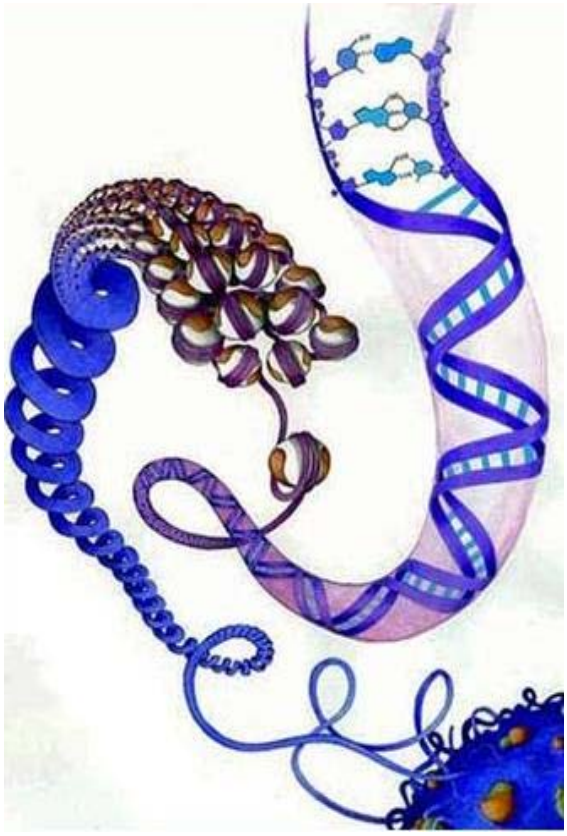


Gialoplazma bilan chegaralanib turadigan tashqi membranasida unga birikkan ribosomalar mavjud, shu tufayli bu qavat donadorli hisoblanadi.Ichki, nukleoplazma bilan tutashadigan membrana silliq, unda ribosomalar yo’q.



Yadro po'sti yadrova sitoplazma orasidagi moddalar almashinuvini nazorat qiladi. Yadrodagi tirqishlar kanallardagi suv to'sma darvozalar kabi undan makromolekulalar, shu jumladan ribosomalarga aylanadigan oqsillarni nukleoplazmadan gialoplazmaga, oqsillarni esa gialoplazmadan nukleoplazmaga o'tishini ta'minlaydi.

Yadroning po'sti tufayli yadroda sitoplazmadagidan farqlanadigan muhit hosil bo'lgan. Retikulyar elementlardagi kabi u ham lipidlar vaoqsillar hosil qiladi, ular esa ma'lum muddat davomida perinuklear bo'shliqda saqlanadi.



Genetic material-DNA

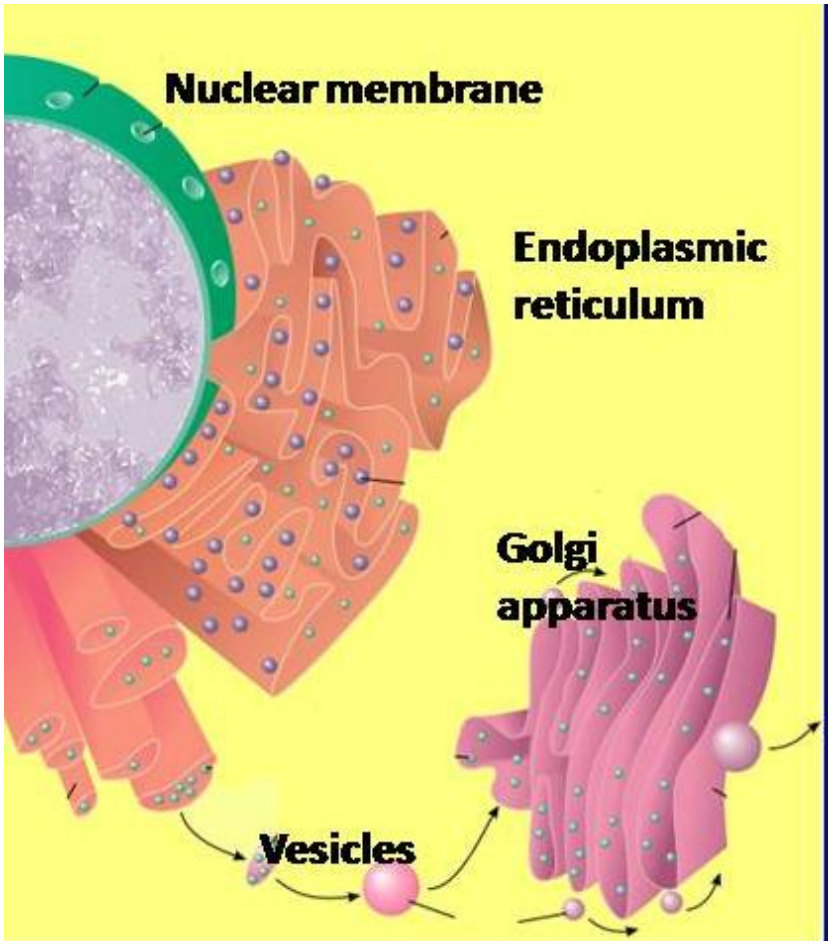
Xromatin ko'p miqdordagi maxsus oqsil-gistonlar bilan bog'langan DNK dan tashkil topgan. Hujayra bo'linayotgan vaqtda xromatin tig'izlanib pirovard natijada *xromosomalarga* aylanadi. Bo'linayotgan hujayrada ya'ni uni interfaza davrida yadroning xromosomalari (xromatin) yadro po'stini biror yoki bir necha joyiga yopishib olgan bo'ladi.

Yadrocha yumaloq anchagina tig'iz diametri ko'pincha 1-3 mkm keladi. U va undagi xromatin membrana bilan o'ralmagan.

Elektron mikroskoplar orqali qaralganda yadrocha asosan ikki-fibrillyar (ipsimon) va granulyar (donador) qismdan iboratligi ko'rinadi. Granullyar qism sitoplazmaning ribosomalariga o'xshab ketadi, biroq kichikroq.Yadrocha xromatinni bir qismi bilan tutashib turadi, ana shu joyda yadroning bo'linishini oxirgi davrida yadrocha hosil bo'ladi.

Hujayra tarkibi;

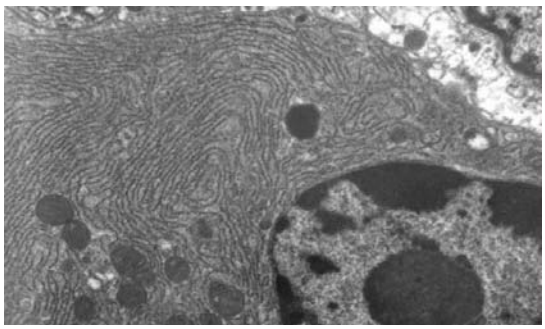
- Endomembrana sistemasi
- Energiya etkazuvchi –Mitoxondriya, Xloroplast
- Peroksisoma
- Vakuola
- Ribosoma
- Sitoskelet



Endomembrana sistemasi

Endomembrana sistemasi o'z ichiga yadro membranasi, endoplazmatik to'r, Golji kompleksi, lizosoma vavesicleni oladi

Busistemabiopolimerlarning – oqsillarnisintez qilish, guruhlargaajratish-sortirovka qilish, hujayradantashqarigaeksport qilish, shuningdekplazmatikmembranavasitoplazmatikmembranakomponentlarinisintez qilishkabiumumiyfunksiyalarnibajaradi.



Endoplazmatikto'r..

Endoplazmatik to'rning kashf etilishi elektron mikroskopning yaratilishi bilan bog'liq. K.R.Porter va uning hamkasblari jo'ja fibroblast hujayralarining elektron mikroskopda kuzata turib bu organoidni kashf qilganlar.

Endoplazmatik to'rning 2 turi aniqlandi:

1. Donador-granulyar 2. Silliq

Donador endoplazmatik to'r bitta membrana bilan o'rab olingan.Membrananing qalinligi 6-7 nm keladi. Endoplazmatik to'rda sisternalar, kanalchalar va bo'ladi. Sisternalar bo'shlig'i, kengligi hujayraning funksional aktivligiga qarab har-xil bo'lishi mumkin. Sisterna bo'shlig'i kengligi 20 nm bo'ladi, ayrim hollarda kengaygan vaqtda diametri bir necha mm keladi.
Donador endoplazmatik to'rning membranasida 20 nm kattalikdagi qora yumaloq va mayda zarrachalar joylashgan, bu zarrachalar Palade tomonidan aniqlangan va ribosoma deb nomlangan.

Silliq endoplazmatik to'r vakuolyar sistema membranasining bir qismi hisoblanadi. Morfologik tuzilishiga ko'ra, bu organoid ham membrana bilan o'rab olingan vakuolalar kanalchalar va sisternalardan iborat. Membranasida ribosoma bo'lmaydi. Silliq endoplazmatik to'r vakuolalari va kanalchalari diametri 50-100 nm keladi.

Golgi apparatus- Golji apparati

Golji apparati bir qavat biologik membrana bilan chegaralangan, 3 xil qismdan tashkil topgan.

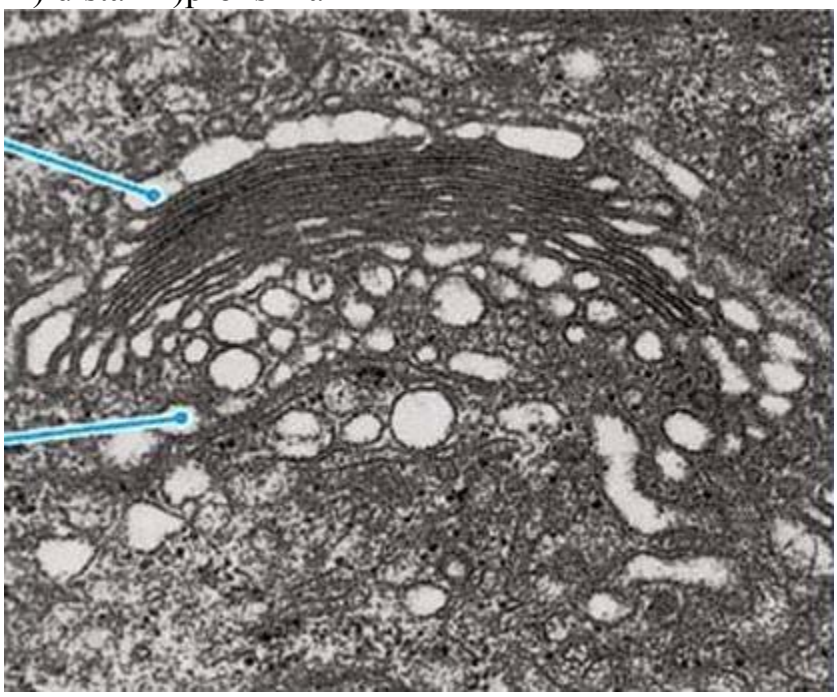
1) Yassi sisternalar sistemasi - silliq membranalar (lamella) bilan chegaralangan. Yassi sisternalar ko'pincha 5-8 ta bo'lib, bir-biriga yaqin yotadi. Sisternalar soni uzunligi va ularni o'zaro masofasi turli hujayralarda bir-biridan farq qiladi. Yaqin sisternalar orasidagi masofa 14-15 nm dan kam emas. Har bir sisterna ichdagi bo'shliq 9-25 nm va undan ko'proq bo'ladi.

2) mayda mikropufakchalar - sisternalar oxirida joylashadi. Mikropufakchalar diametri 30-50 nm

3) yirik vakuolalar - membranalar bilan o'ralgan. Vakuolalar kattaligi 6-7dan 10 nm gacha bo'ladi. Sisternalar orasi 200-250 A kenglikda matriks bilan to'lgan.

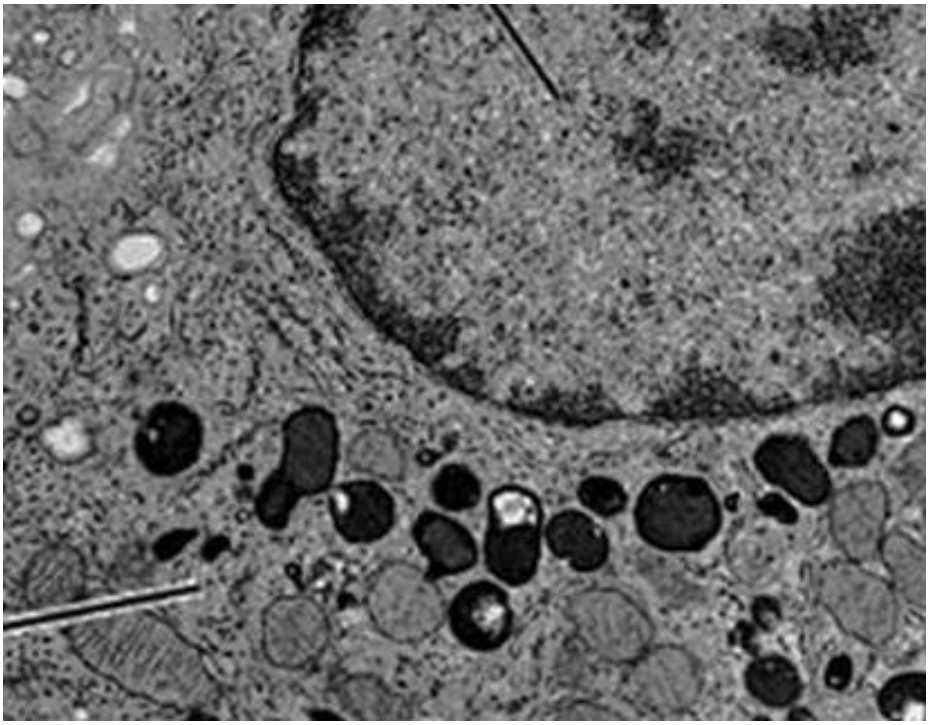
Sisternalar diktiosomada 6 ta sisterna bo’lib, tuban eukariotlarda 30 dan ko’p bo’lishi mumkin. Golji apparatidagi diktiosomani 2 tomoni uchastkasi farq qilinadi.

1) distal 2)proksimal

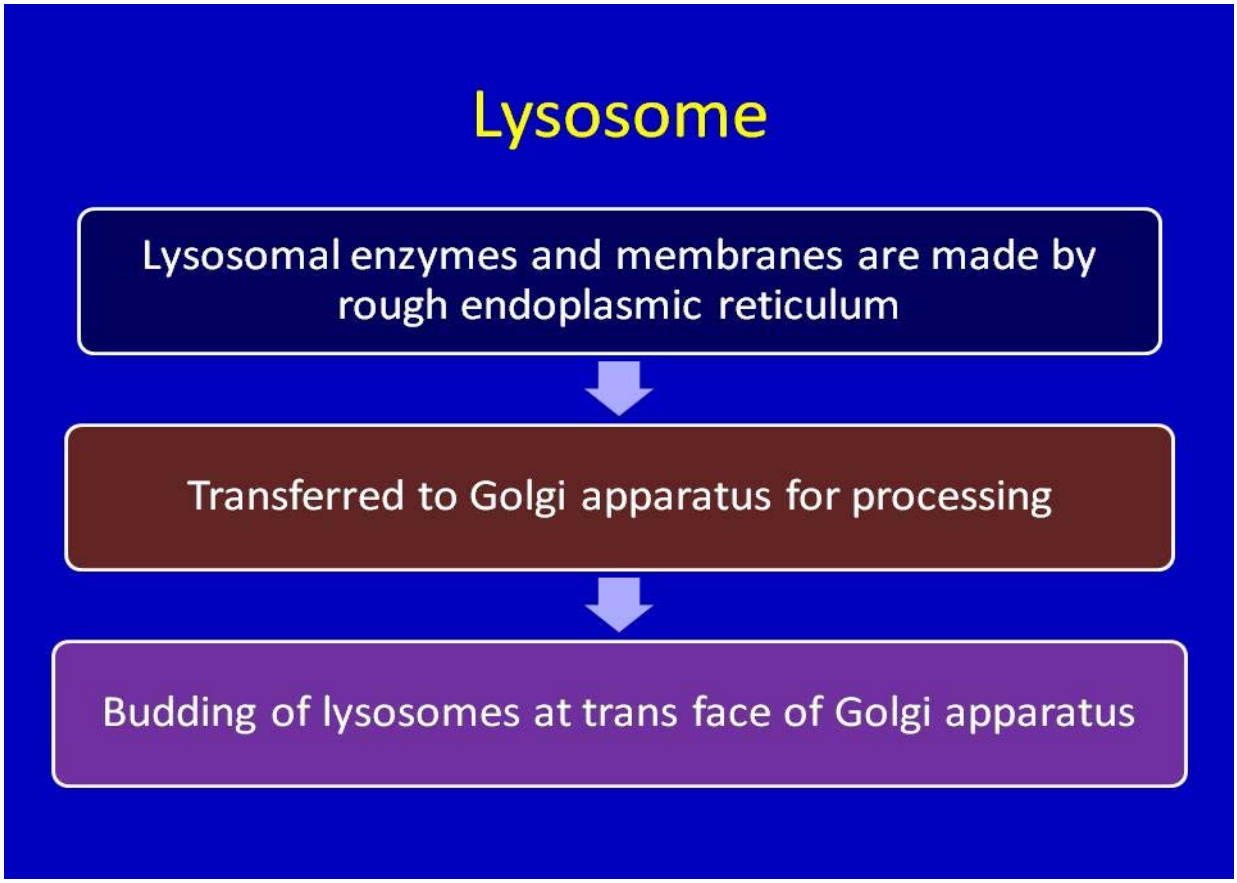


Lysosome

Lizosomalar lipoprroteid membrana bilan o’ralgan Ayrim kuzatishlarga qaraganda ular plastinkasimon komplekslarda hosil bo’ladi.. Lizosomalar membranasida oqsil tashuvchi transport strukturalar mavjud bo’lib ular gialoplazmaga gidroliz mahsulotlari aminokislotalar, qandlar, nukleotidlar, lipidlarni tashib beradi



Lisosoma shakllanishi

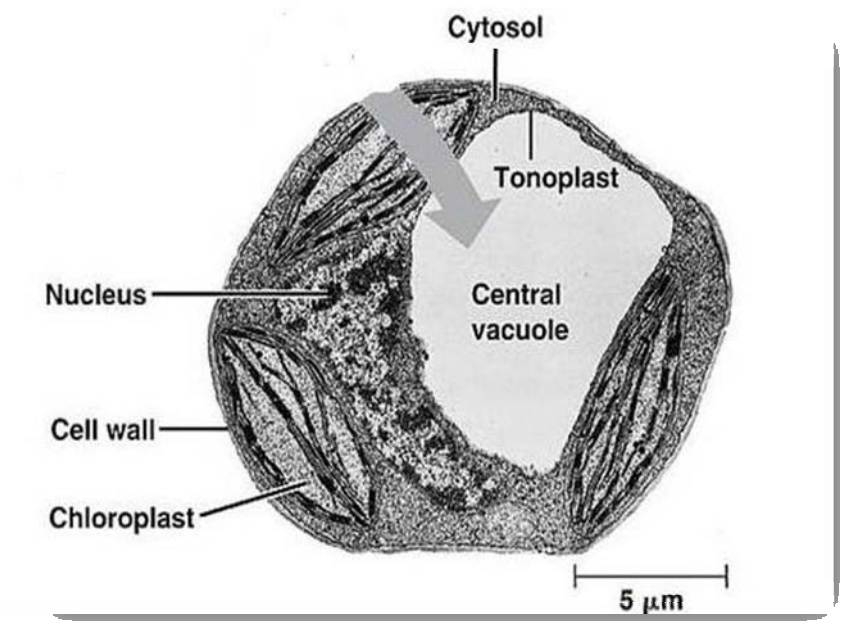


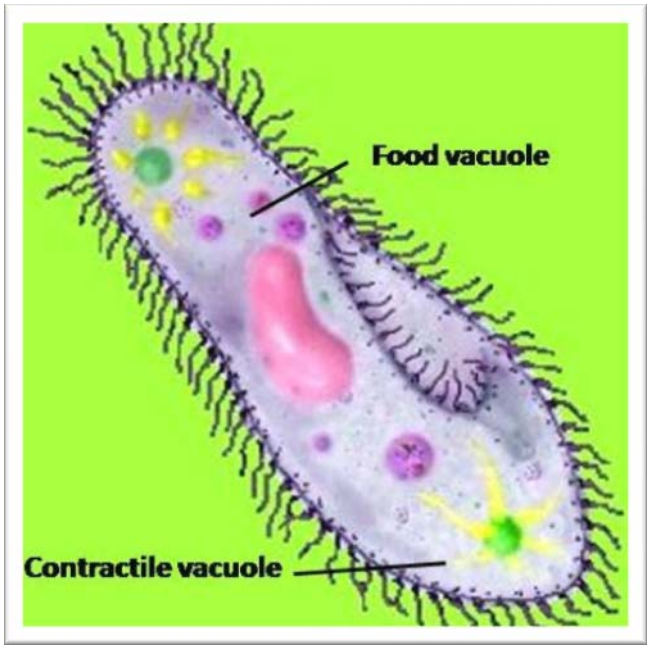
Lizosoma fermentlari va membranasi donador EPT da tayyorlanadiva Golji apparatiga tashiladi

Vacuoles- Vakuola

Vakuolalar gialoplazmadan membrana bilan ajralib *hujayra shirasi* deb ataladigan suyuqlik bilan to'lgan qopsimon hosiladir. Ular tonoplast yoki vakuola membranasi bilan o'ralgan.

Yosh hujayralarda odatda ko'p miqdorda mayda vakuolalar bo'lib, kattalashib borgan sari o'zaro qo'shilib qari hujayralarda bittaga aylanadi..





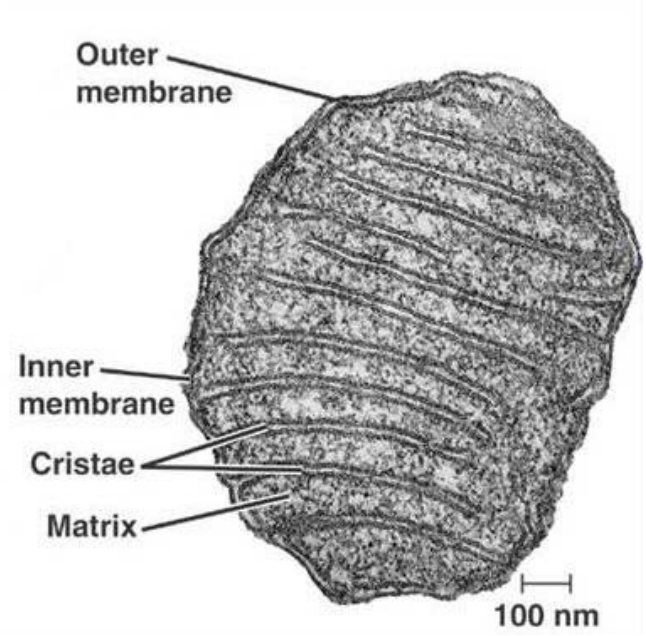
Hayvon hujayrasida hazm qiluvchi va qisqaruvchi vokuolalar bo'ladi.

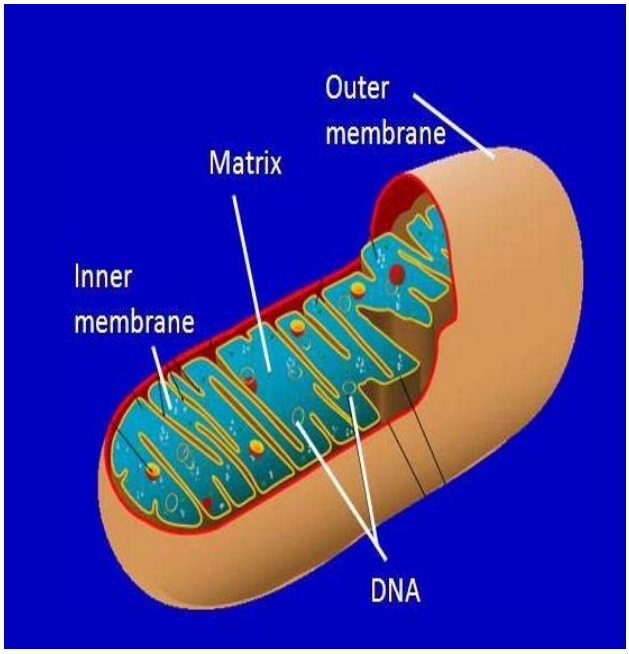
Mitochondria

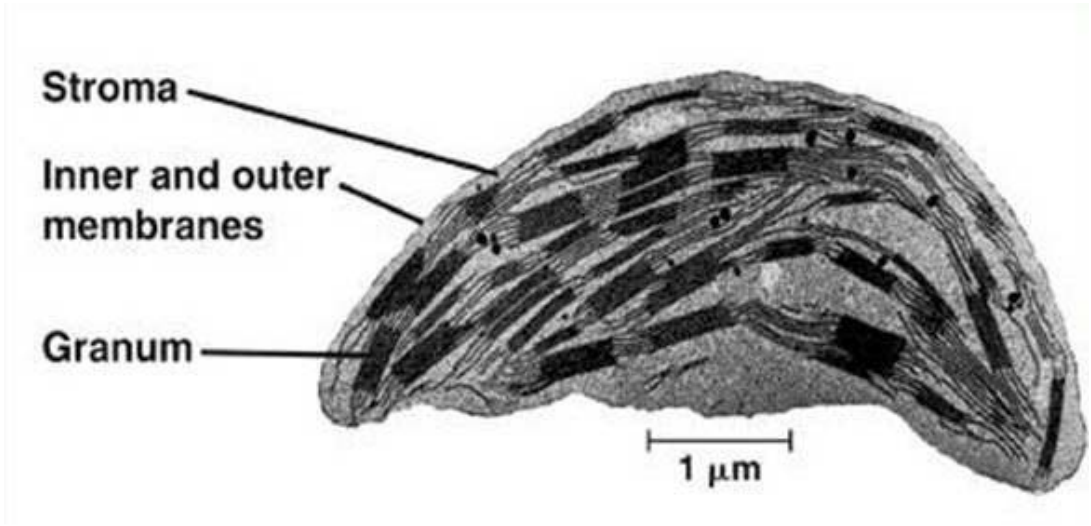
Mitoxondriyalarningasosiyvazifalari-ATFniADFdan hosil qilish, ya'niboshqachaaytganda hujayranienergiyagabo'lgantalabini qondirish hisoblanadi.Mitoxondriyalardanajralganenergiyagaboy ATFmolekulalari hujayraning hayotiyfaoliyatinita'minlashda, unibo'linishida, moddalarnishimishvaajratishyo'li, sintezjarayonlaridafoydalaniladi.

Mitochondriastructure– Mitoxondriya tuzilishi

Mitoxondriya qo'sh-tashqivaichkimembranabilan o'ralganularning orasidagibo'shliq (10 nmgayaqin) suyuqlikbilanto'lgan. Tashqimembranamitoxondriyanisitoplazmadanajratibturadivamoddalaralmashinuvi niboshqaradi. Ichkimembranatashqisidan ximiyaviytarkibibilanfarqlanadi. Ichkimembranamitoxondriyaichigayo'nalganturlichauzunlikdagiyassi o'simtayokinaychako'rinishidagimitoxondriya*kristalari*debataladigan o'simtalarni hosil qiladi. Kristalar orasi*matriks*gomogentuzulmabilan to'lgan.





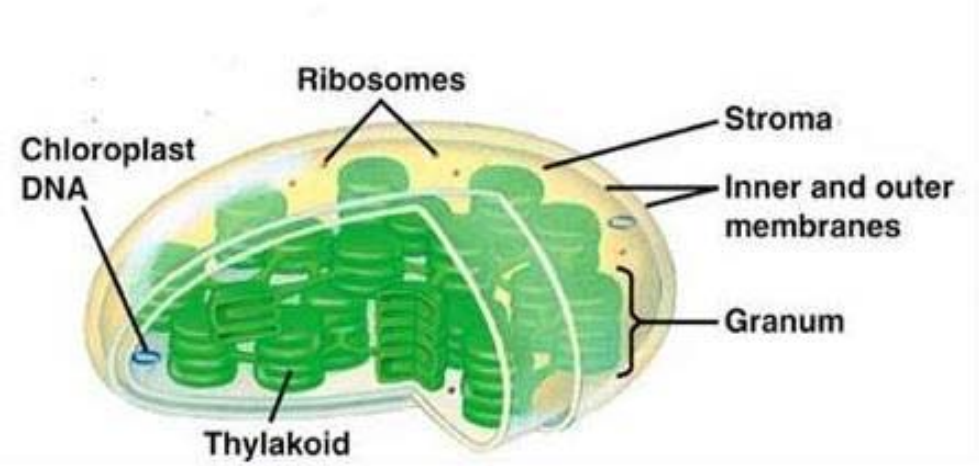


Mitochondria are semiautonomous organelle- Mitoxondriya yarim avtonom organella

Mitoxondriyalarda yadroga bog'liq bo'lmagan holda o'zidagi ribosomalar yordamida mitoxondriya DNK nazoratida oqsil hosil qiladi. Ba'zi hujayralardagi mitoxodriyalar efir moylarini (uglevodlar) hosil bo'lishida ishtirok etadigan lipidlarni jadval ravishda sintezlaydi.

Chloroplast- Xloroplast

Xloroplast fotosintezlovchi organoid ular o'simlik hujayrasida topilgan



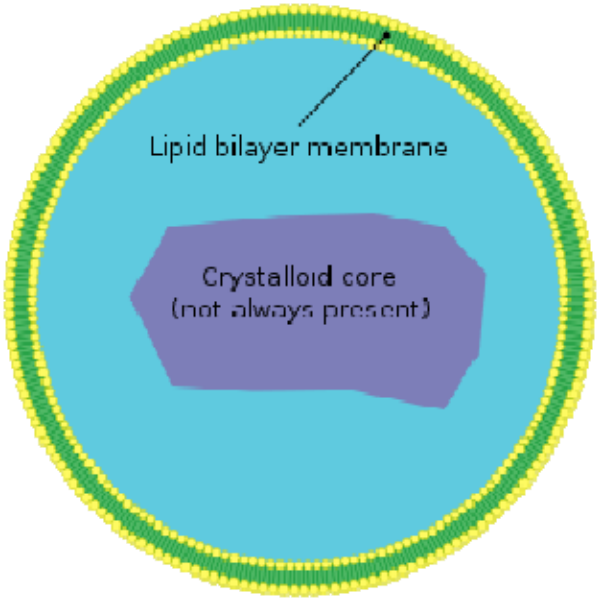
Po’stning membranalari silliq ribosomalari yo’q. Xloroplastlarning muhim belgisi - ichki membrana yuzasining yorug’likni tutib qoladigan qat’iy tartibdagi tuzilma holida bo’lganligidir. Ularda xlorofillar jamlangan. Ichki membrana *tilakoidlar* yoki lamellalar deb ataladigan yassi qopchalar ko’rinishiga ega. Tilakoidlar yuksak o’simliklarda yassi shaklda bo’lib, *granalar* deb nomlanadigan to’plamlar holida bo’ladi. Tilakoidlar granalarda ma’lum tartibda membranalari bilan o’zaro taqalib turadi. Granalardagi tilakoidlarni soni o’simlik turiga va yoritilganlik darajasiga bog’liq. Ayrim o’simliklarda bor - yo’g’i 2-3 ta boshqalarida bir necha o’nlab bo’ladi. Granalar o’zaro tilakoidlarning stromalari yordamida tutashadi. Stromaning tilakoidlarini granalari tilakoidlarnikidan farqlanib bir biridan biroz nariroqda turlicha masofada joylashadi, ularni o’lchamlari ham turlichaChloroplast –

Xloroplastlarda o’ziningDNKvaribosomalarinibo’lishiularda oqsil hosil qiladigan hususiytuzilmalarnimavjudliginibildiradi.
Chloroplastis**semiautonomousorganelle**.

Peroxisomes

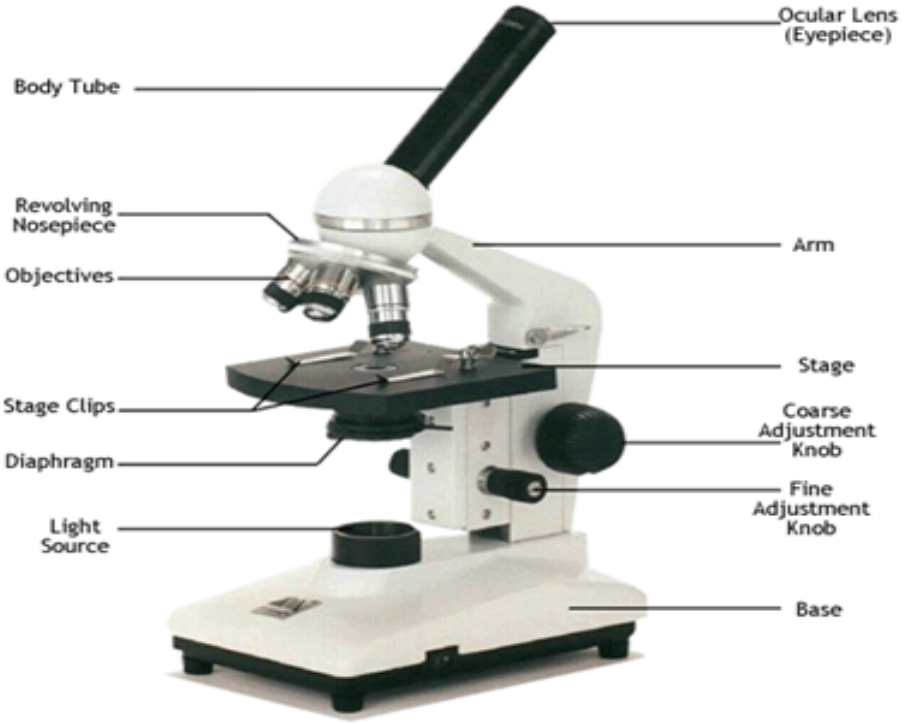
Peroksisomalar unchalik katta bo’lmagan 0,3-1,5 mkm kattalikdagi 1 ta membrana bilan o’ralgan organoid bo’lib, markaziy qismida o’zak yoki nukleoid (yadro strukturalariga taalluqli emas) bo’ladi
Peroksisomalar fraksiyasida vodorod peroksid metabolizmi bilan bog’liq fermentlar aniqlangan. Bu fermentlar (oksidaza, urat oksidaza, d-oksidazasida) aminokislotalarni oksidlovchi dezaminirlashishida qatnashuvchilardir. Bu

jarayonlarda vodorod peroksid hosil bo'ladi va uni katalaza parchalaydi.



Peroksisomalar

Peroksisomalar unchalik katta bo'lmagan 0,3-1,5 mkm kattalikdagi 1 ta membrana bilan o'ralgan organoid bo'lib, markaziy qismida o'zak yoki nukleoid (yadro strukturalariga taalluqli emas) bo'ladi. Jigar hujayralari peroksisomalarida o'zak qismida kristal strukturalar mavjud. Ular fibrilla yoki naychalar taxlamlaridan tashkil topgan. Peroksisomalarni izolyatsiya qilingan o'zagida urat oksidaza fermenti mavjud. Peroksisomalar sodda hayvonlarda – (amyoba, tetraxinema), tuban zamburug'larda (achitqilarda) yuksak o'simliklarni hujayrada (endosperm) va yashil qismlarida (fotorespiratsiya qiluvchi) uchraydi.

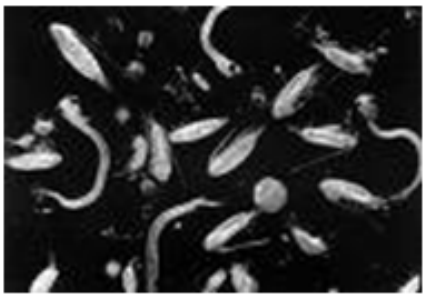


Compound Microscope

- Robert Hooke – 1665
- Piece of cork
  - –Observation – cells are filled with juices

Anton Van Leeuwenhoek

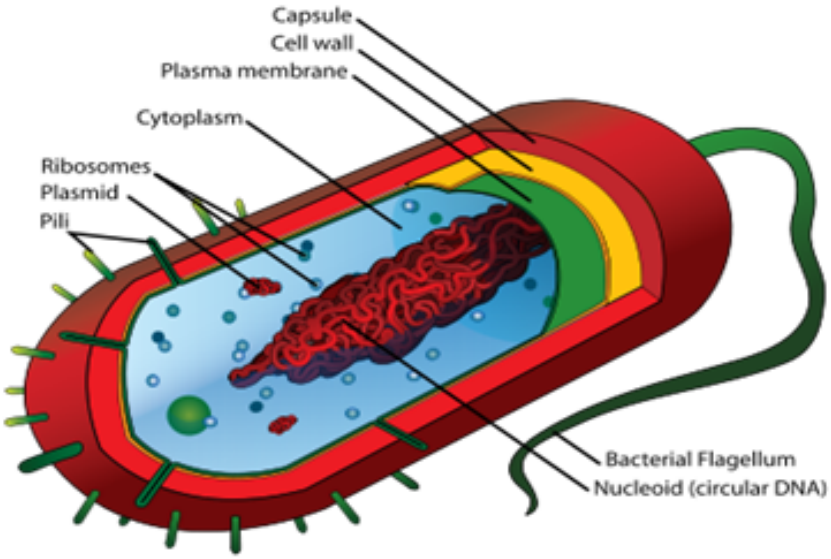
- 1670 – pond water
- Discovered animalcules
  - Now called microorganisms

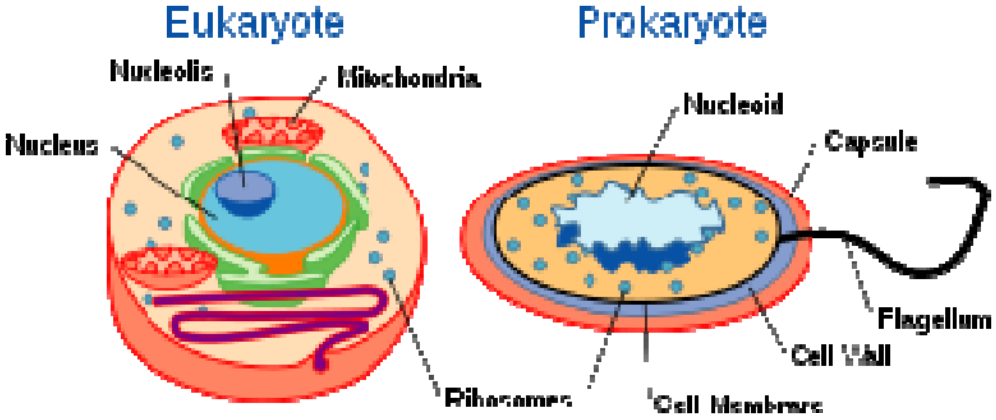


Two Types of Microscopes

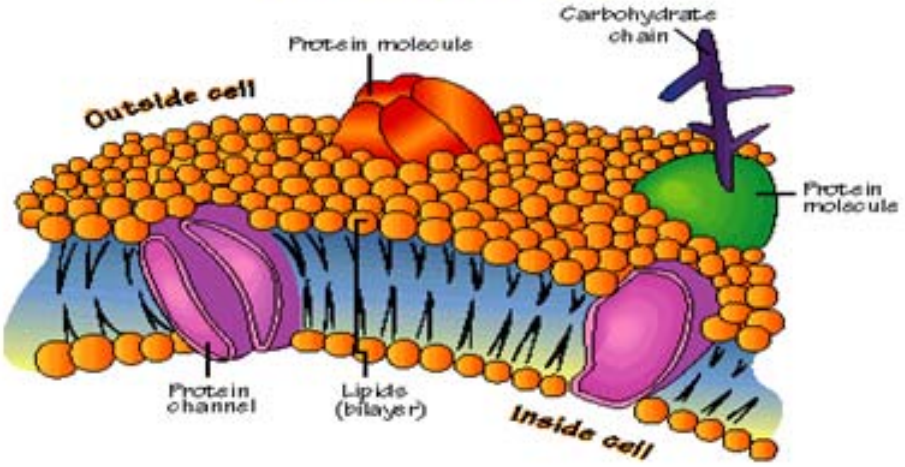
- Light
  - Glass lens and light rays
- Electron
  - Electrons instead of light

Prokariot hujayra tuzilishi

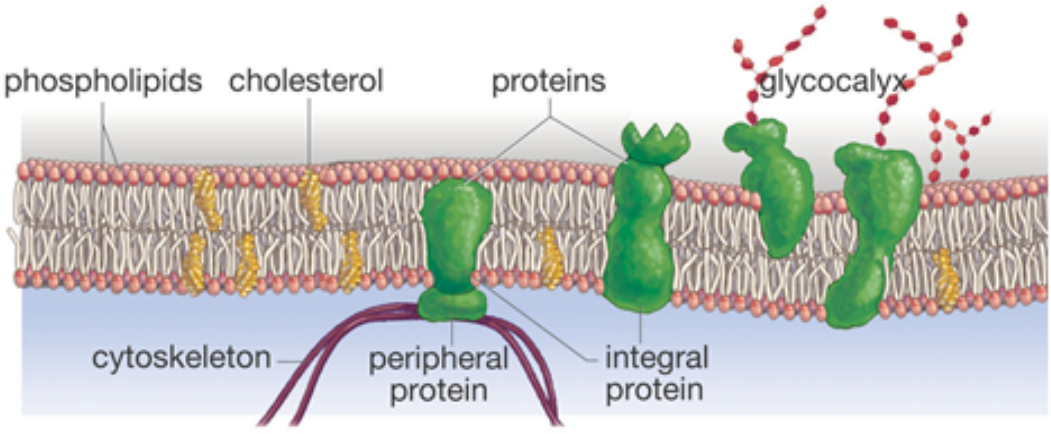




Structure of the Cell Membrane



Membrane Components

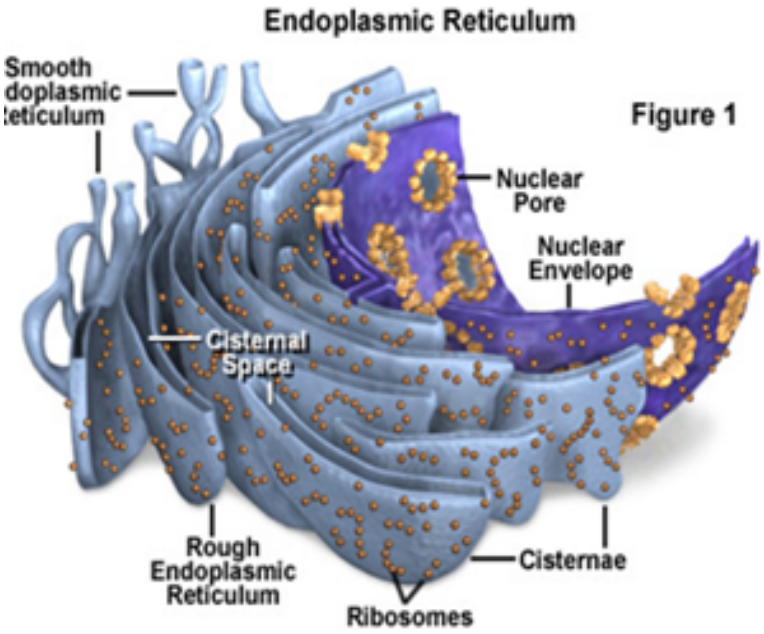


- Phospholipid bilayer
- Cholesterol
- Proteins
- Glycocalyx

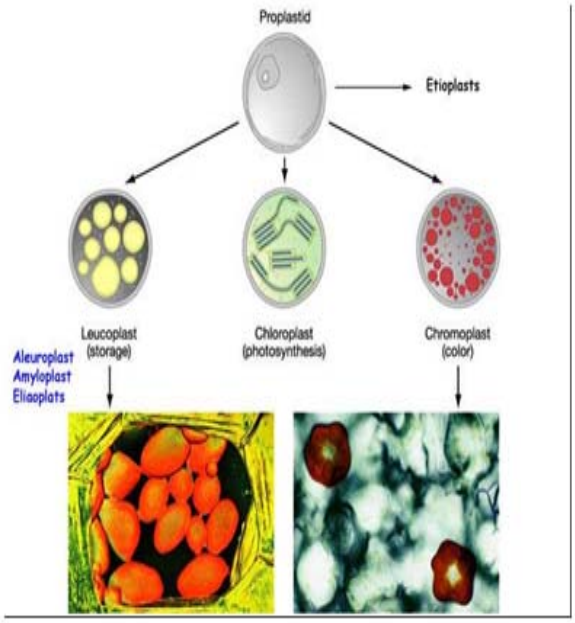
Phospholipids

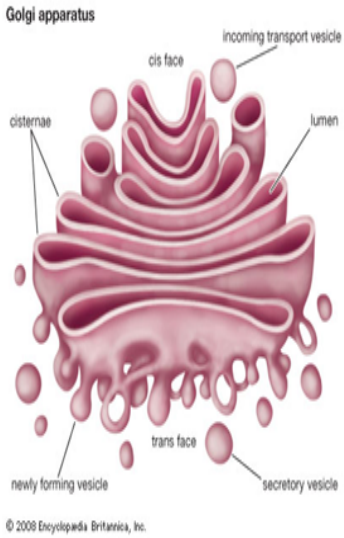
Cholesterol

Carbohydrates (glucose)



- Endoplazmatik to'r O'ta mikroskopik kanalchlar va sisternalarning o'zaro tutashishidan iborat murakkab shaxlangan to'r sistemasi ekanligi aniqlangan. Kanallar diametri 350-500 A keladi, membranasining qalinligi 70 A
- Elektron mikroskopda o'rganish natijasida endoplazmatik to'rning 2 turi aniqlandi:
- *1. Donador-granulyar*
  2. Silliq



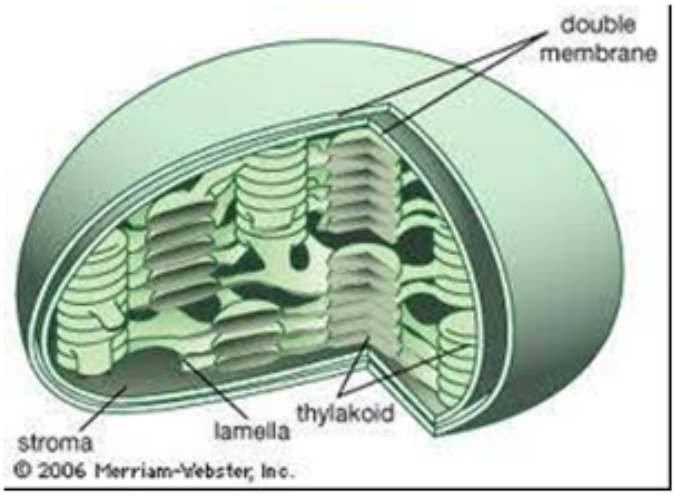


- Golji apparatidagi diktiosomani 2 tomoni uchastkasi farq qilinadi. 1) distal 2)proksimal ya'ni strukturaviy va bioximik jihatdan qutblangan proksimal qutbi sitoplazma va yadroga qaragan. Proksimal qutbda membrana qalinligi 6-7nm, distal qutbda 10 nm bo'ladi.

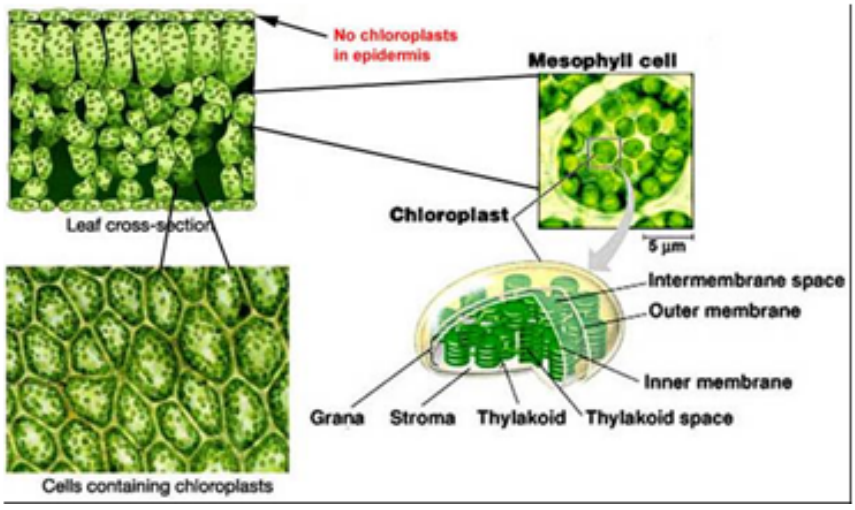
Proksimal qutbda yangi sisternalar shakllanadi. Distal qutbga tomon yetilib boradi. Distal qutbga yirik vakuolalar hosil bo'ladi.

Proksimal qutb yangi shakllanadigan qism bo'lgani uchun ham shakllanayotgan tomon yoki - sis tomon deb ham yuritiladi. Distal qutbi esa yetuk yoki trans tomon deb yuritiladi..

Xloroplast tuzilishi



Barg hujayralarida xloroplastni joylashishi va bitta xloroplastni tuzilishi



Lizosomalar

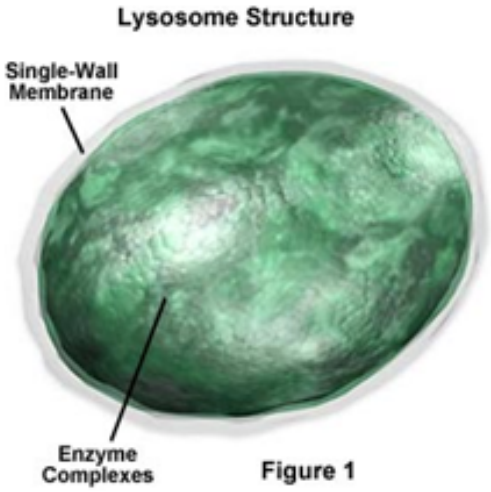


Figure 1

- Lizosomalarni bioximik Kristian De Dyuv 1955 (1949) yilda kalamush jigar hujayralarida kashf qilgan. Lizosomalar (lotincha lizis–eritmoq, soma-tana) hujayraning bir membranali organoidi hisoblanadi. Lizosomalar tarkibida oqsil nuklein kislotalar polisaarid va lipidlarni parchalaydigan gidrolitik fermentlar bor. Lizosomani asosiy xususiyatlaridan biri uni matriksida proteinaza, nukleaza, glikozidaza, fosforilaza, fosfataza, sulfataza kabi fermentlar mavjud. Bu fermentlar uchun muhit pH=5 bo'lganda (kislotali) optimum hisoblanadi.

Lizosomaning anotomik tuzilishi

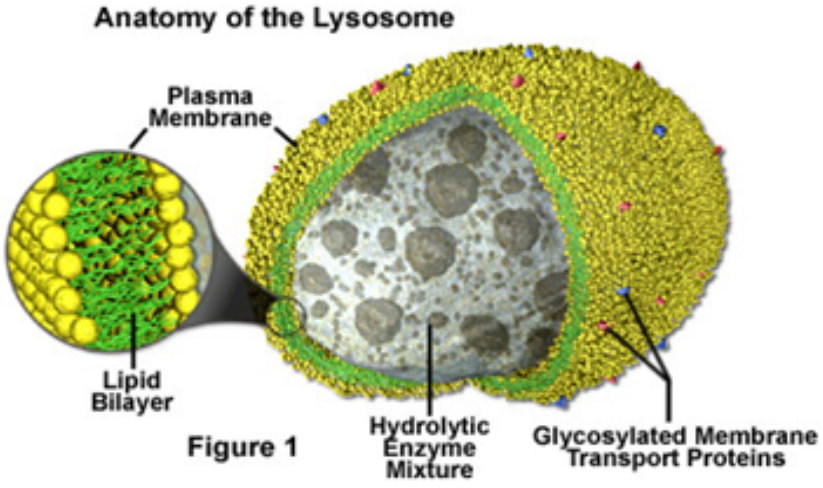
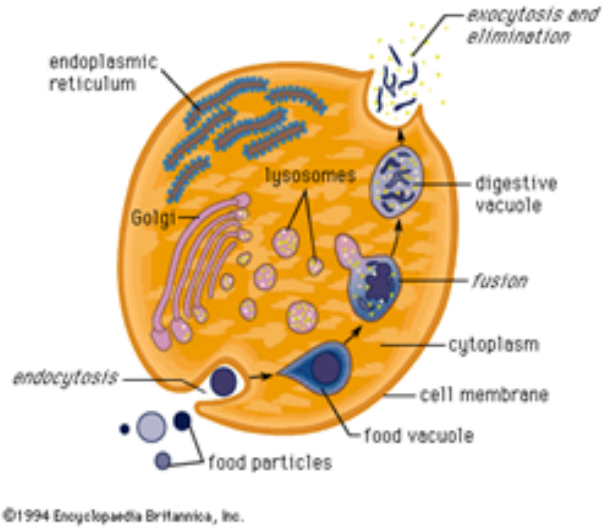


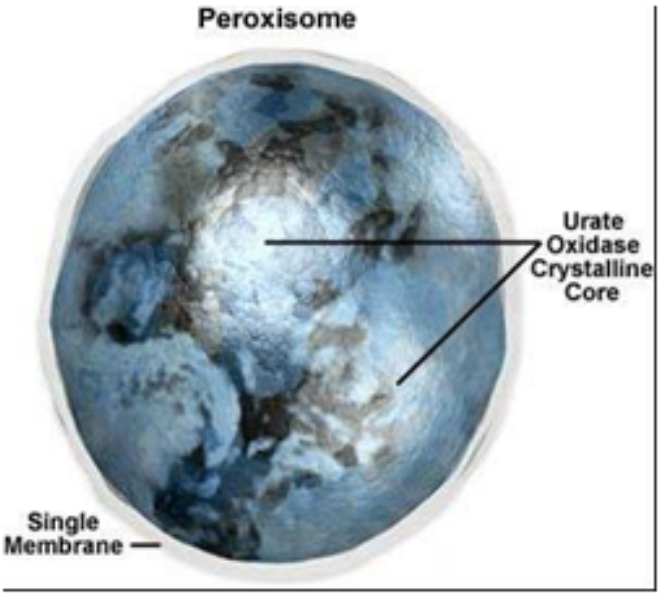
Figure 1

Lizosomada moddalar emirilishi

Lizosomani hujyrani militsiyasi deyish mumkin. Chunki ular tarkibida fermantlar bor bo'lib ular endoplazmatik tor r tomonidan maxsus lizosomalar uchun ishlab chiqariladi va hujayra ichidagi tartibni o'rnatib yot moddalar bakteriyalar, oziq modda va qarigan organellalarni emirib turadi

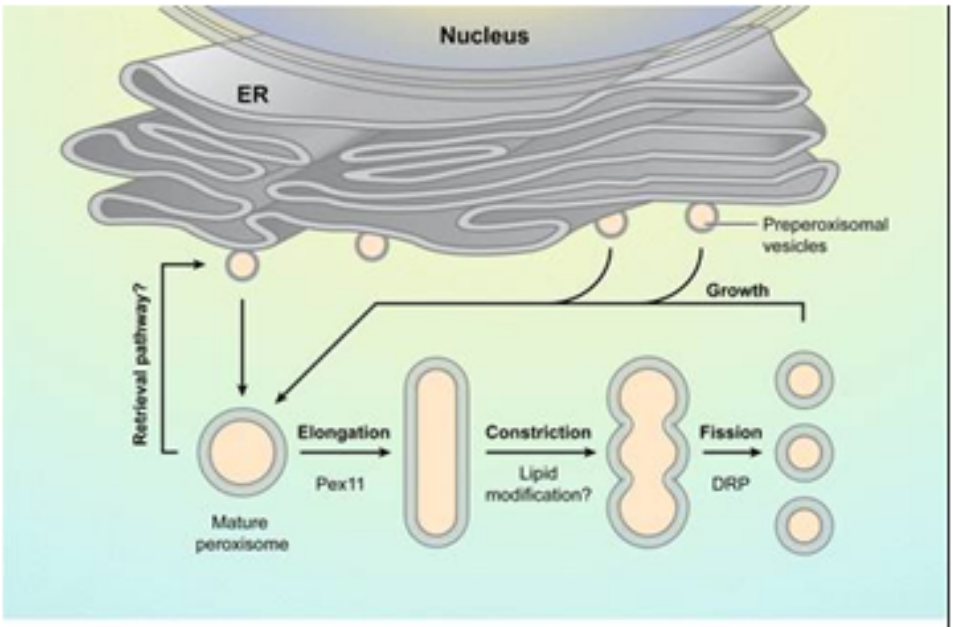


Peroksisomaning tuzilishi



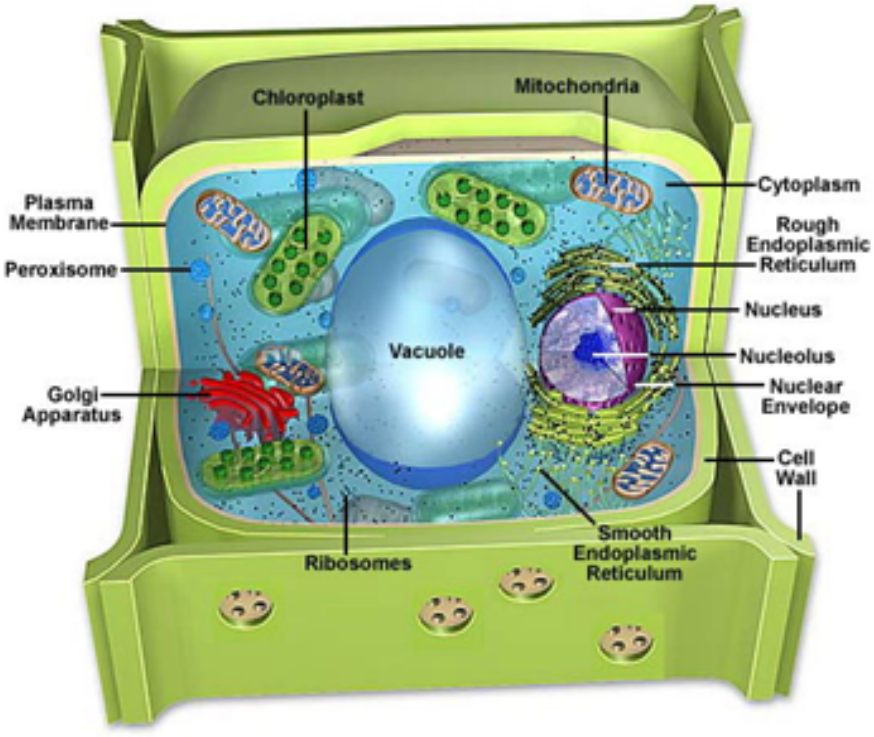
- Peroksisomalar unchalik katta bo'lmagan 0,3-1,5 mkm kattalikdagi 1 ta membrana bilan o'ralgan organoid bo'lib, qismida kristal strukturalar mavjud. Ular fibrilla yoki naychalar taxlamlaridan tashkil topgan. Peroksisomalarni izolyatsiya qilinganda o'zagida urat oksidaza va katalaza fermenti mavjud.

Peroksisomaning hosil bo'lishi



Fagarasanu A, et al. 2007.
Annu. Rev. Cell Dev. Biol. 23:321–44

Vakuolani hujayrada joylashishi



Hujayra yadrosining umumiy tuzilishi

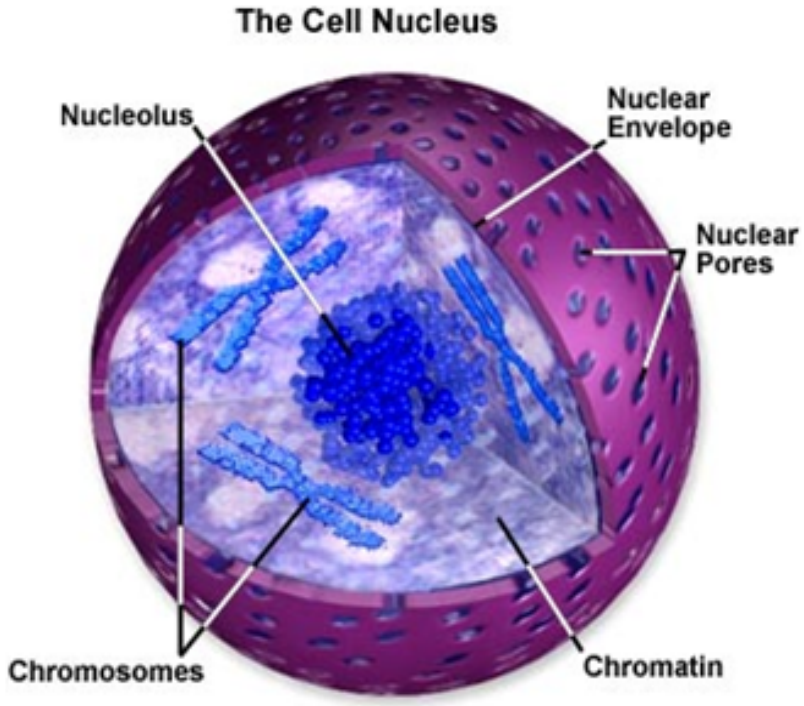


Figure 1

Yadroning anatomik tuzilishi

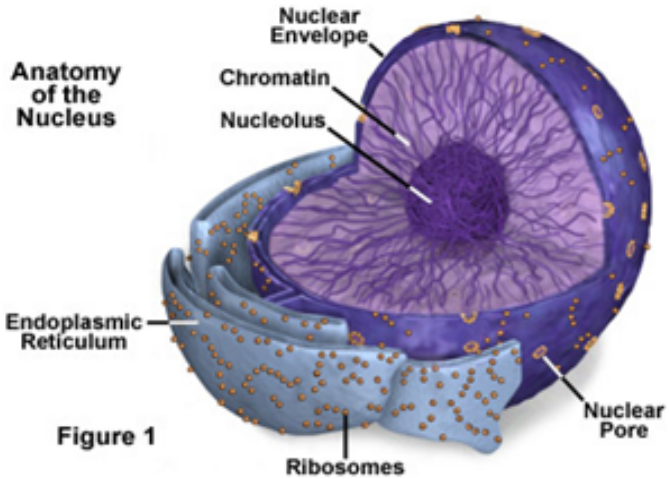
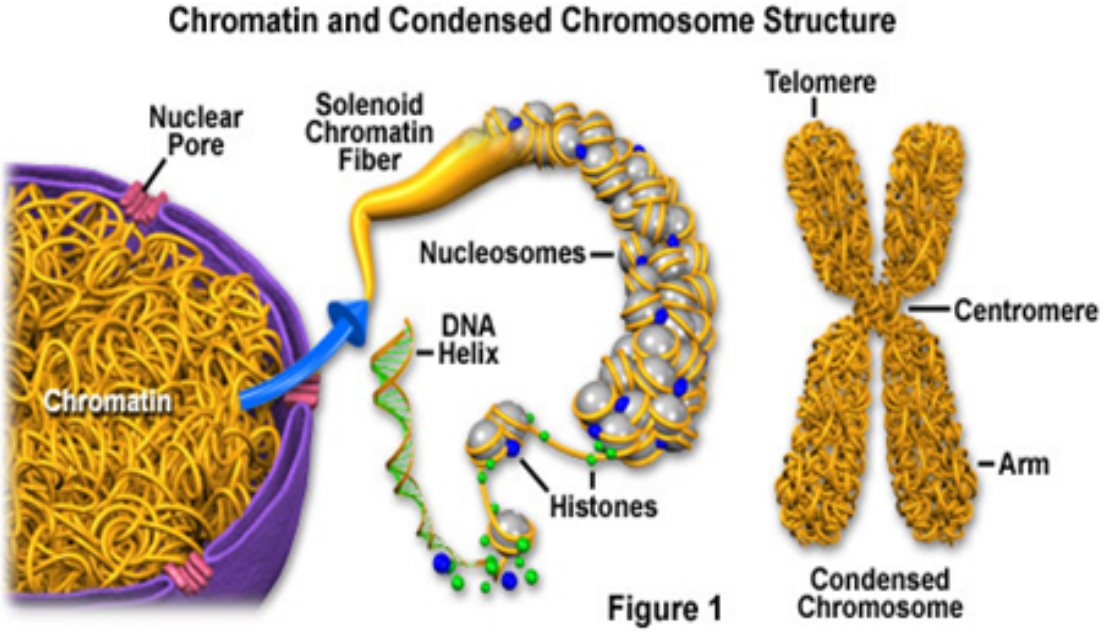
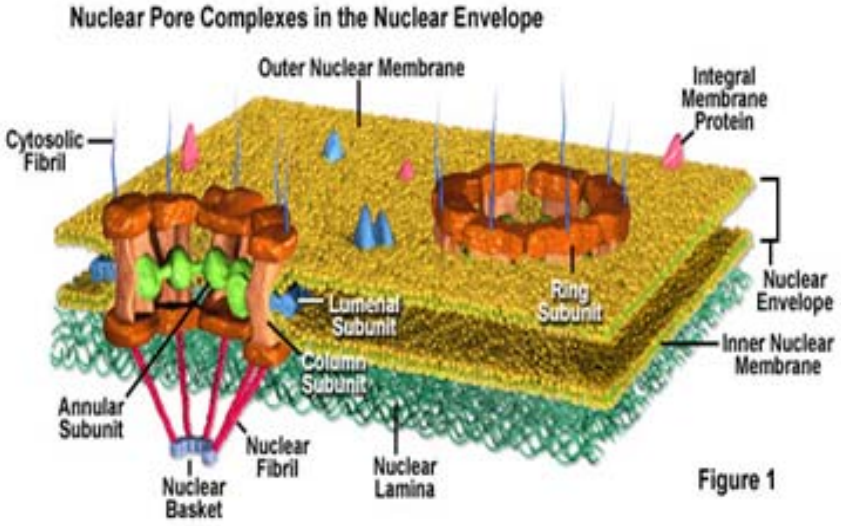


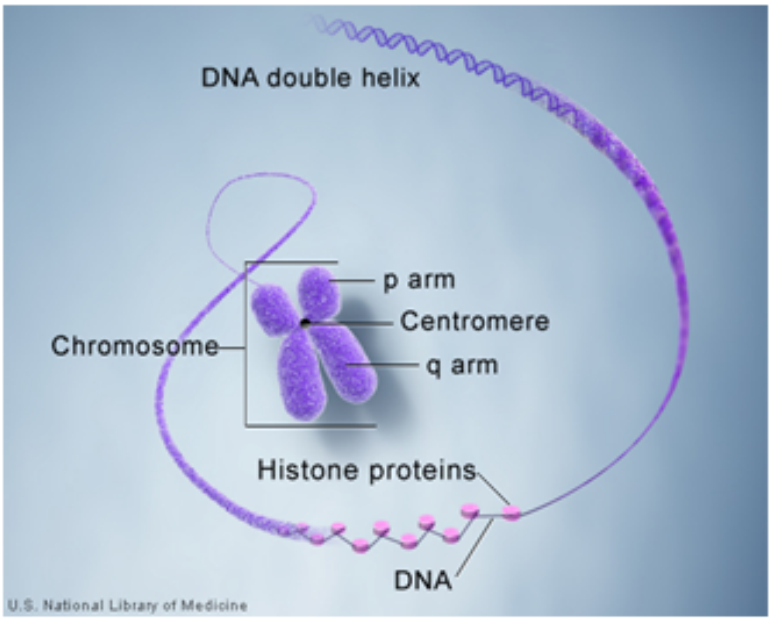
Figure 1

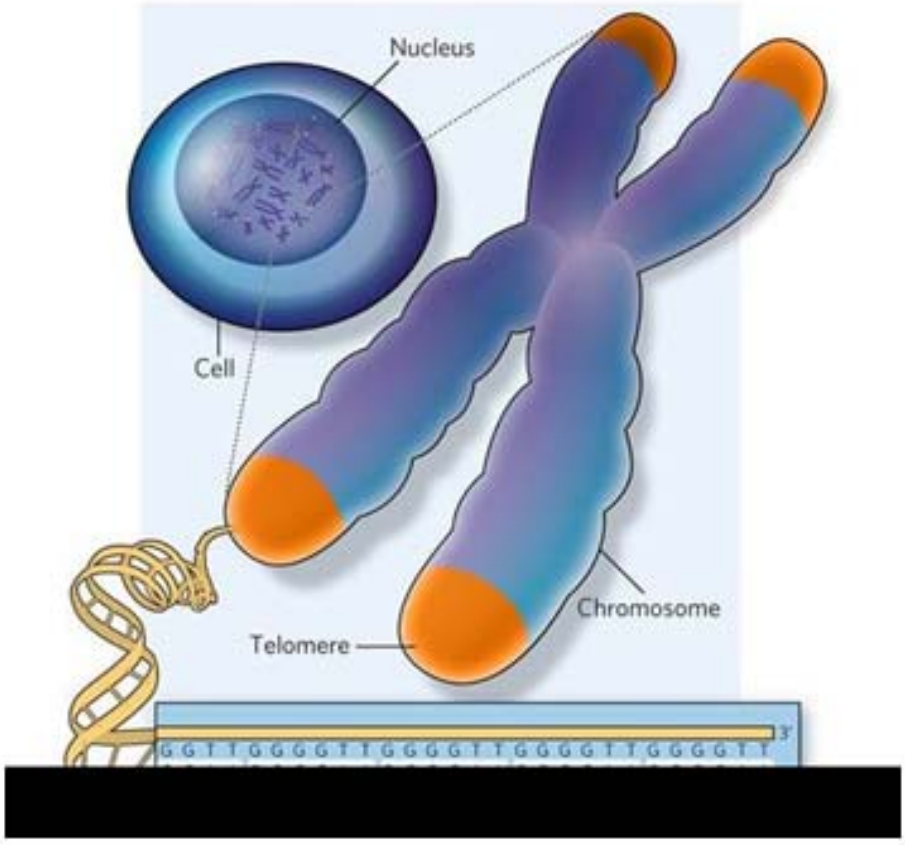
Xromatin va xromosomalarning ko'rinishi



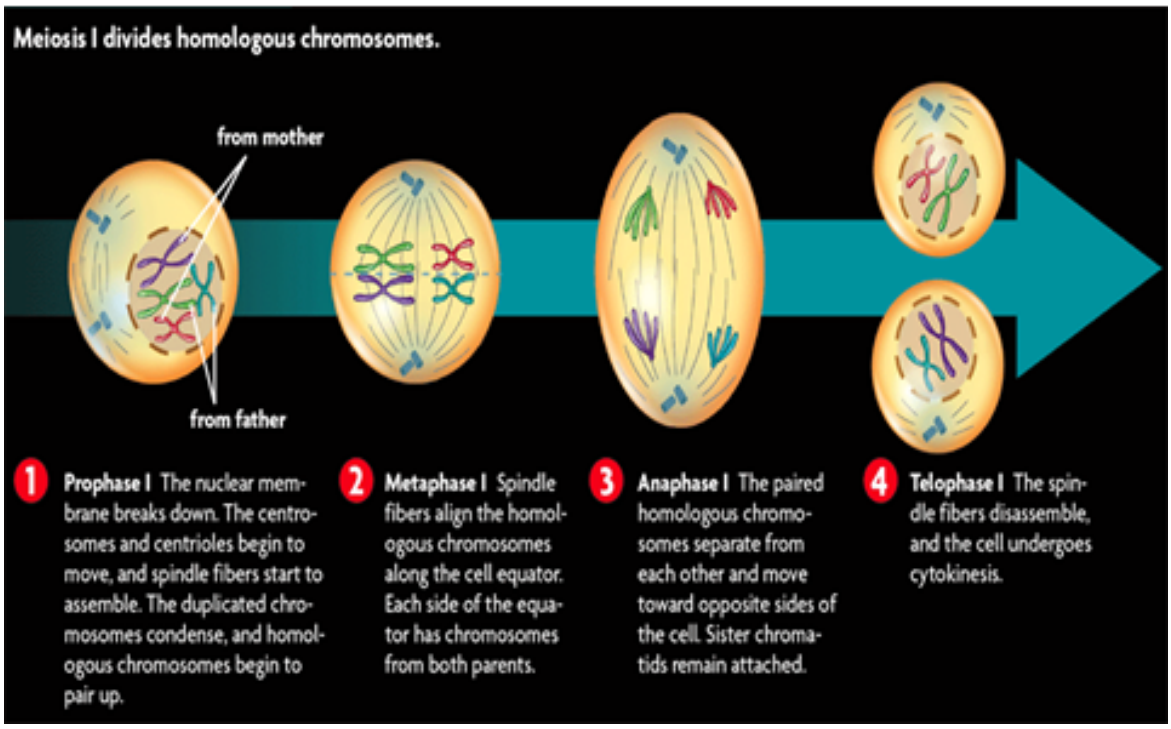


DNK va gistonli oqsillar yig'indisi xromatin bo'lib ular yig'ilib xromosomani tashkil qiadi

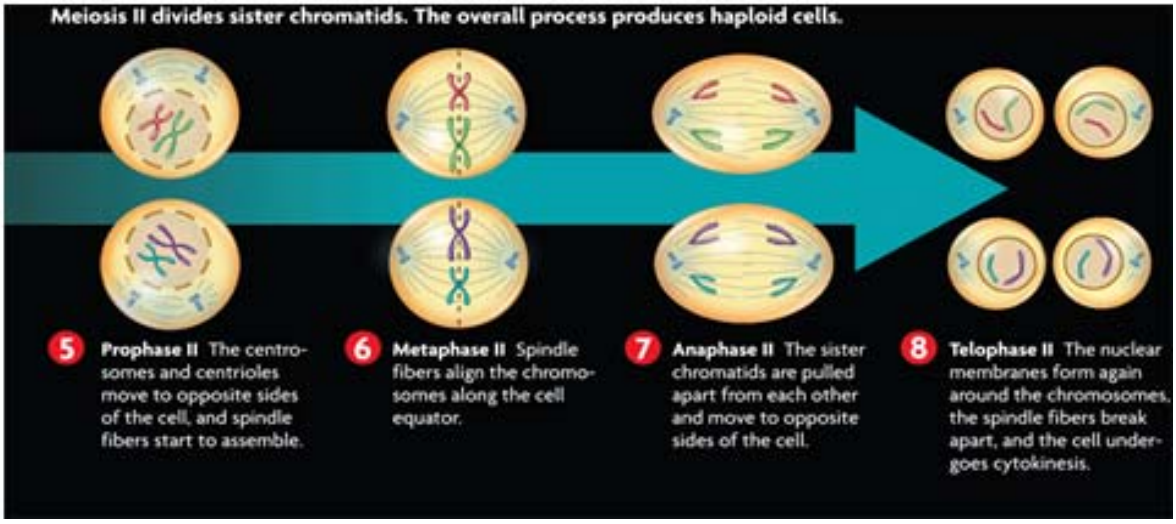




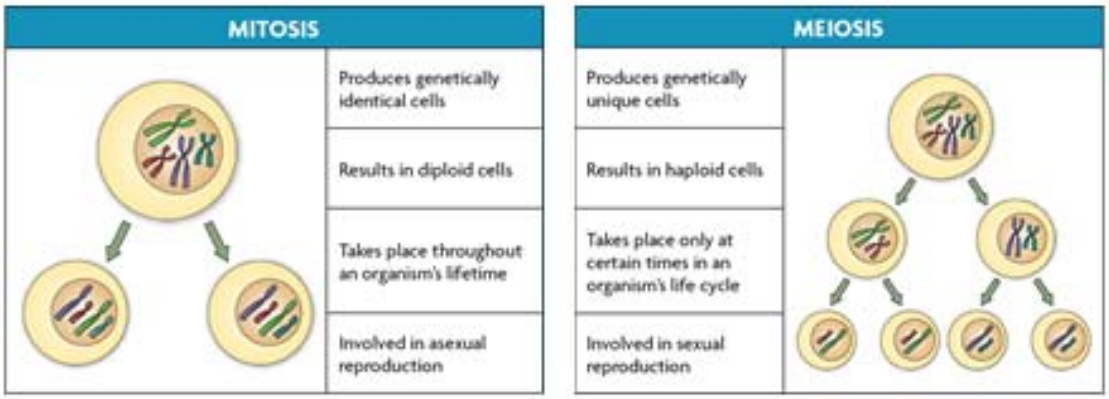
Meiosis I: Prophase I, Metaphase I, Anaphase I, Telophase I



- Meiosis II divides sister chromatids* in four phases.
- DNA is not replicated between meiosis I and meiosis II.
- **remember a sister chromatid = copy of same DNA*



- Meiosis differs from mitosis in significant ways.
  - Meiosis has two cell divisions while mitosis has one.
  - In mitosis, homologous chromosomes never pair up.
  - Meiosis results in haploid cells; mitosis results in diploid cells.



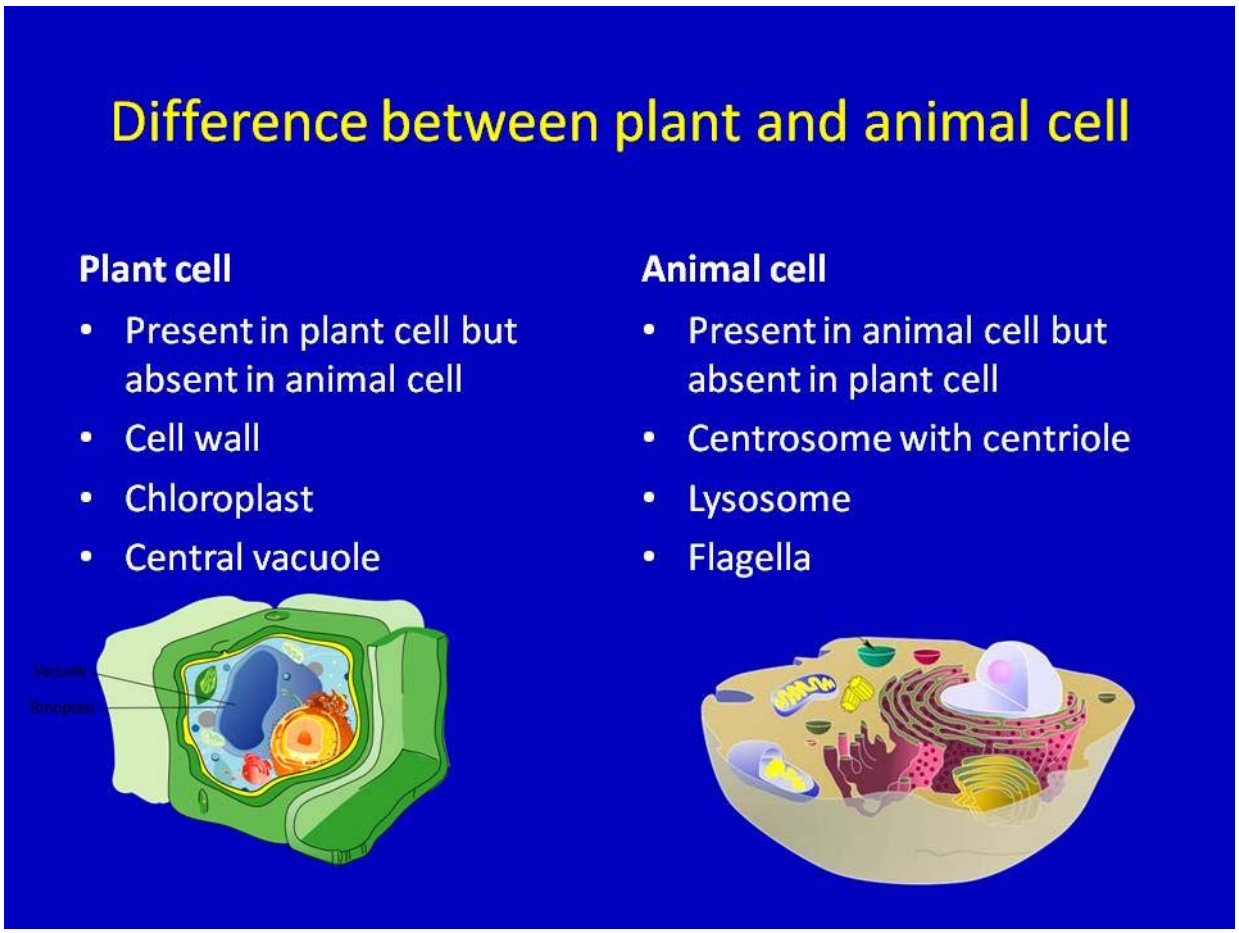
SITOLOGIYA FANIDAN GLOSSARY

1. Abberatsiya – xromosomalar struktura o'zgarishining bir formasi
2. Adenin - azotli arganik birikmalar bo'lib u adenine nukleotidi tarkibiga kiradi
3. Amitoz - hujayralarning to'g'ri bo'linish usuli
4. Anafaza – hujayraning mitotic va meyotik bo'linishdagi bir fazasi
5. Aneuplodiya –hujayradagi ayrim xromosomalar sonining normadan ko'payishi (2n+1) yoki kamayishi (2n-1)
6. Androgenez - murtakning spermatozoid yadrosi hisobiga rivojlanishi
7. Autosomalar- jinsiy bo'lmagan xromosomalar
8. Axromatin - hujayra bo'linishida aktiv ishtirok etadigan mikronaychalardan hosil bo'lgan ipchalar
9. Bivalent- meyoz bo'linishining zigotena bosqichida konyugatsiyalanadigan ikkita gomologik xromosomalardan iborat bo'lgan juft xromosomalar
10. Vereteno- hujayra axromatin ipchalaridan tashkil topgan duk naysimon tolalar
11. Gametafit – o'simliklarda gametalardan hosil bo'ladigan normadagi gaploid avlodi
12. Gen – DNK molekulasining organic asosiga ega bo'lgan bir qismi. U organizmga qaratilgan ekstremal ta'sirlar natijasida yuz beradigan

o’zgarishlarda muhim ro’l o’ynaydi. Uning asosida organic moddalar ma’lum tartibda o’z o’rnini topgandir.

13. Geterexromatin - xromosomalarning yaxshi bo’yaladigan qismi
14. Geteropiknoz – xromosomalar spirallangan davrida butun xromosomalar yoki uning sigmentlari bir xilda jipslashmasligi
15. Gomologik xromosomalar- tuzilishi jihatdan o’xshash bo’lgan va allel genlarning bir xil yig’indisini tashiydigan xromosomalar
16. Guanin- azotli organik birikma bo’lib, guanin nukleotidi tarkibida bo’ladi
17. Diakenez – meyozda profaza 1 ning oxirgi bosqichi bo’lib bunda xromatidlar kalta va yo’g’on tortadi
18. Diploid – somatic hujayralrda juft gomologik xromosoma yig’indisi yoki urug’lanish natijasida xromosomalr soni ikki marta ortgan organizm
19. Diplotena- meyozning profaza 1 bosqichidagi davri
20. Zigotena – meyoz bo’linishining profaza 1 dagi bosqichi
21. Interfaza- bo’lingan yosh hujayraning keyingi bo’linishga tayyorlanishi
22. Kariogramma- idiogramma- kariotipning sxematik ifodalanishi
23. Kariotip – xromosomalar sonii, shakli, yelkalarinig joylashgan o’rni, sentromeraning holati yo’ldoshning bor yo’qligi, EU va va geteroxromatinning taqsimlanishi va h
24. Kariologiya – sitologiyaning hujayra yadrosi to’g’risidagi sohasi
25. Karioplazma - yadro shirasi
26. Kod – DNK molekulasi zanjiridagi nukleotidlarning navbatlangan holda joylanishi
27. Kolxitsin - kolxikum o’simligidan olinadigan alkaloid modda
28. krosiingover - birinchi meyotik bo’linishning profazasida konyugatsiyalanadigan gomologik xromosomalarning xromatidlari o’rtasida o’xshash qismlarning o’rin almashuvi yoki chatishivi
29. Leptotena - meyoz bo’linishning profaza1 bosqichi davri
30. Lokus – xromosomada gen joylashgan o’rin
31. Metafaza – mitoz va meyozning o’rta stadiyasi
32. Meyoz – jinsiy hujayraning bo’linish usuli
33. Mitoz tana hujayralarining bo’linish usuli
34. Mitoxondriya hujayra organoidi
35. Miofibrill – muskul hujayrasining tolalari
36. Neyrit – nerv hujayrasining eng uzun va yagona o’simtasi
37. Nukleotidlar – uch xil modda: fosfat kislota, uglevod va azotli asos molekulasi qo’shilishidan vujudga kelgan murakkab organic modda
38. Ovogenez - tuxum hujayrasining rivojlanish protsessi
39. Organoidlar - hujayrada ma’lum vazifani bajaradigan elementlar
40. Partenogenez – urug’lanmagan (otalanmagan) tuxum hujayradan murtak rivojlanishi
41. Paxitena meyoz bo’linishda profaza 1 ning zigotena bosqichidan keyingi davr
42. Politeniya- gigant xromasomalar hosil bo’lishi

43. Poliploidiya- o’simlik va hayvon hujayralaridagi gaploid xromosomalar yig’indisining ikki, uch, to’rt hissa va undan ko’p marta oshishi
44. Profaza- mitoz va meyoz bo’linishning birinchi fazasi
45. Reduplikatsiya- xromosoma strukturasining ikkilanishi natijasida yangi xromasomalarnning vujudga kelishi
46. Ribosomlar- hujayraning oqsil sintezlovchi organoidi
47. RNK- ribonuklein kislotaning qisqartirib yozilishi
48. Sputnik (Yo’ldosh) – xromosomaning ikkinchi tortmasidan keyingi ipchali qismi. Yo’ldoshning o’lchami xromosoma bilan teng yoki kichik bo’lib, ingichka ip bilan bog’langan
49. Telomeralar – xromosomalarning chekka qismi
50. Telofaza – hujayra (yadro)ning mitotik va meyotik bo’linishining oxirgi davri
51. Timin - azotli organik birikma bo’lib, timin nukleotidi tarkibida bo’ladi
52. Transplantatsiya- xromosomaning uzilib qolgan qismining gomologik bo’lmagan boshqa xromosoma bilan birikib qolishi
53. Uratsil- azotli organik birikma bo’lib, uratsil nukleotidi tarkibida bo’ladi
54. Xromatid - Xromasomaning DNK sintezidan keyin hosil bo’lgan qismi
55. Xromatin – Yadro modda. Xromasomalardan, dezoksiribonukleoproteiddan (DNP), gistondan va qisman RNK dan tashkil topgan
56. Xromomerlar – Xromosoma ipidagi xromonemadan marjon shaklida ko’rinadigan tanalar
57. Xromonema- ko’p sonli elementar xromosoma fibrillalaridan yoki xromofibrillalardan tashkil topgan. U submikroskopik nucleoprotein tolalaridan iborat
58. Xiazm- meyozda xromatidlar o’rtsida krosingover va genlar almashinishi natijasida vujudga keladigan butga o’xshash shakl
59. Xromosentr- Xromosomaning alohida geteroxromatin zonasi bo’lib, o’z strukturasini interfazada saqlab qoladi
60. Sentromera (kinetoxor) xromosomaning ikki qismga bo’linadigan mexanikaviy markazi
61. Sentrasoma- hujayra yadrosi yonida joylashgan organoid
62. Sentrasferalar- hujayra markazi atrofida joylashgan sferik qism, u yulduzcha shaklida
63. Sitokenez – hujayraning bo’linishi
64. Sitoplazma – Hujayraning yarim suyuq holatdagi maddasi. Unga yadro va uning qobig’Idan boshqa hamma organoidlar kiradi
65. Endomitoz – bo’lingan xromosomalarning qutblarga tarqalmasdan poliploid hujayra hosil bo’lishi
66. Euxromatin- xromosomaning kuchsiz bo’yaladigan qismi. Geteroxromatinga nisbatan aktiv bo’lib, o’zida genlarni saqlaydi



Cell: A Guided Tour

Kamal Kumar Gupta, Associate Professor

Deshbandhu College, University of Delhi

A variety of life forms exists in the biosphere

- Plants
- Animals
- Microorganisms

Despite great deal of differences these forms exhibit common characters of living beings. This raise some basic questions such as:

What is building block of life?

What is its structure?

How is basic life processes performed?

How is the information of life contained, expressed and inherited?

Cell is basic, structural and functional unit of life.

Cell is basic unit of life.

Cell is the smallest unit of living organism.

Cell is building block of life.

Cell is structural unit of life.

All the living structures are made up of cell.

Cell is functional unit of life.

All the functions of life are ultimately performed by the cell.

Cell contains all the information related to its **structure**, **function, expression** and **inheritance.**

Cell is a specific organization of molecules

Basic structure of cell

- A limiting membrane: Plasma membrane.
- An internal environment: Cytoplasm.
- A molecule containing information of life: DNA

Cell organization

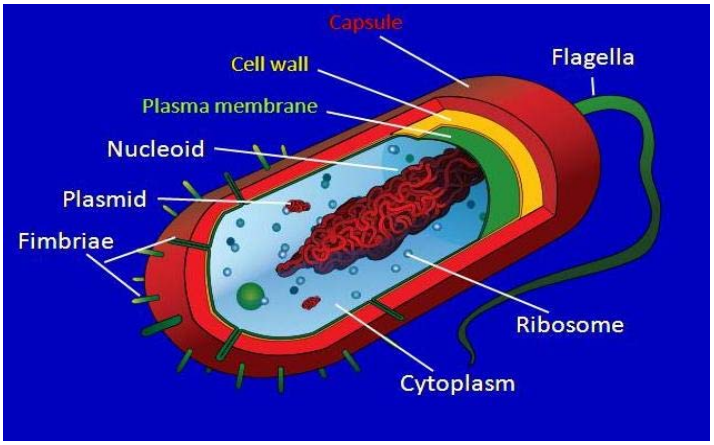
Prokaryotes

Prokaryotes includes bacteria, cyanobacteria and archeaobacteria

Eukaryotes

Eukaryotes include protist, fungi, plants and animals.

Structural Organization of prokaryote cell



- The outer most living membrane is plasma membrane It is protected by cell wall made up of peptidoglycan, and a jelly like capsule.
- Fimbriae are the structure on the surface for attachment.
- Flagella are the organelles for locomotion.
- DNA is concentrated in the region called nucleoid.
- The true membrane bound nucleus is absent.
- DNA is circular not organized into chromatin material.
- Small circular plasmid DNA may also be present.
- Cytoplasm contains ribosomes for protein synthesis, proteins, enzymes and other metabolites for various life processes.

Structural organization of eukaryotic cell

The eukaryotic cell is divided into many sub cellular compartments. The main structures are:

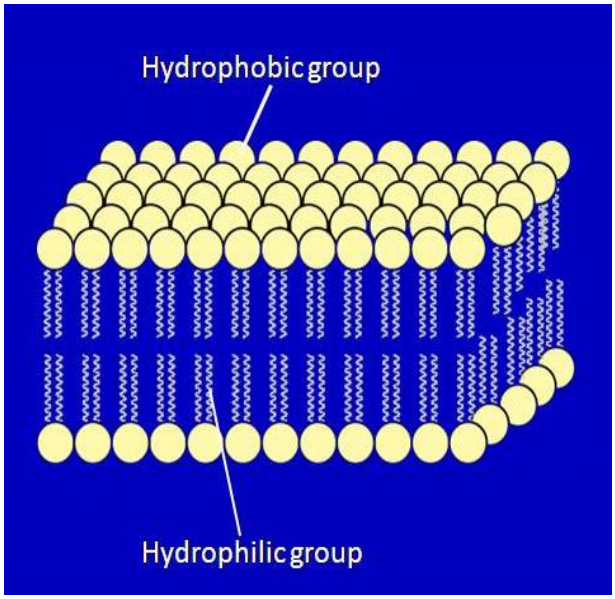
- Plasma membrane
- Nucleus
- Cytoplasm

Plasma membrane

Plasma membrane is limiting membrane. Plasma membrane is integral part of the cell. It is selective permeable. It separates the internal environment of the cell from external environment. It helps in interaction of cell with external environment

Plasma Membrane – Structure

The plasma membrane is a **trilaminar** structure. It is formed of a **lipid bilayer** and associated proteins. The proteins may be embedded in the lipid bilayer- **integral protein** or present at periphery **-peripheral proteins.**



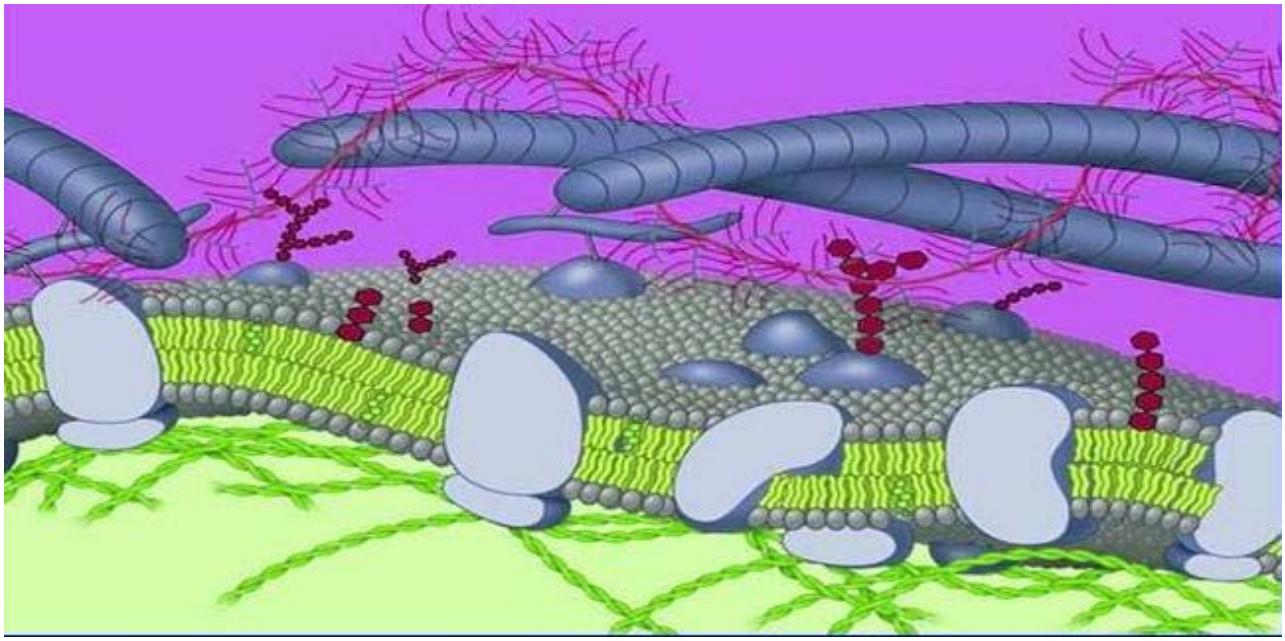
Main components of Lipid bilayer are **phospholipids**. The phospholipids are **amphipathic** in nature. They contain both hydrophilic and hydrophobic group in the same molecule. The hydrophobic groups are fatty acids. Two fatty acids are attached to glycerol backbone. Hydrophilic group include a variety of molecules attached to glycerol with the help of phosphoric group.

Arrangement of phospholipids in the bilayer is such that the hydrophobic end lies in the centre and hydrophilic ends are present toward periphery.

Plasma Membrane - Fluid Mosaic Model

Fluid mosaic model was proposed by Singer and Nicholson. It states that:

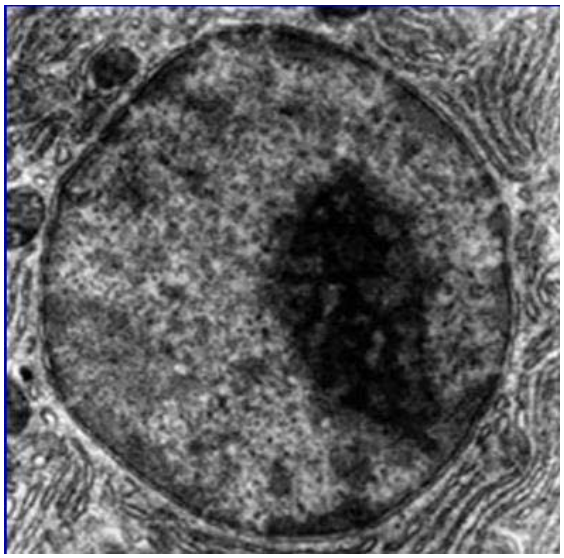
- Plasma membrane is quasifluid structure
- There is asymmetry in distribution of phospholipids and protein



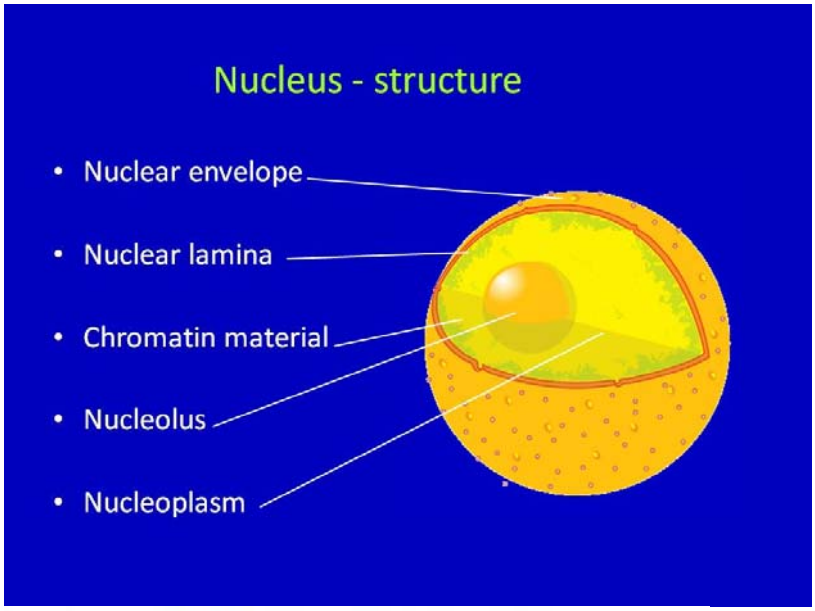
- The protein and lipid molecules are not static but constantly perform movements

Nucleus

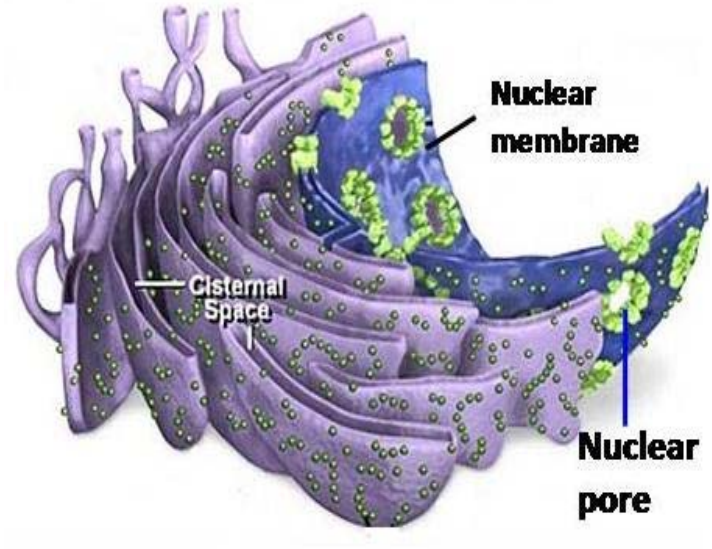
The nucleus contains most of the **genetic information** of life. It is responsible for storage, **expression and inheritance** of genetic information.



Normally a single nucleus is present. Some cells contain two or more nuclei. Human RBCs are without nucleus.



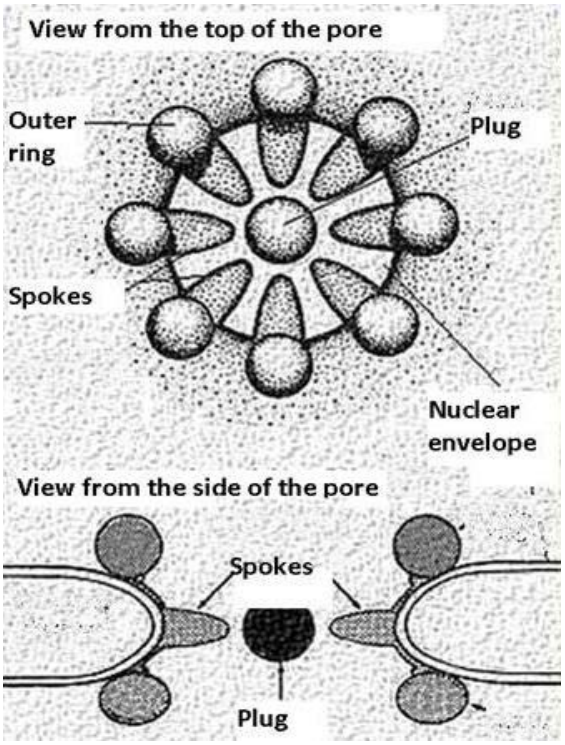
The nucleus consists of **nuclear membrane, nuclear lamina, chromatin material, nucleolus and nucleoplasm.**



Nuclear envelope

Nuclear envelope is **double membrane**. Each membrane is lipid bilayer with associated proteins. The outer membrane is connected with endoplasmic reticulum.

The nuclear envelope is perforated by nuclear pores. At the lip of pore the outer and inner nuclear membrane are continuous.



Nuclear Pore Complex

An intricate protein structure – **Pore complex** consisted of proteins is associated nuclear pore.

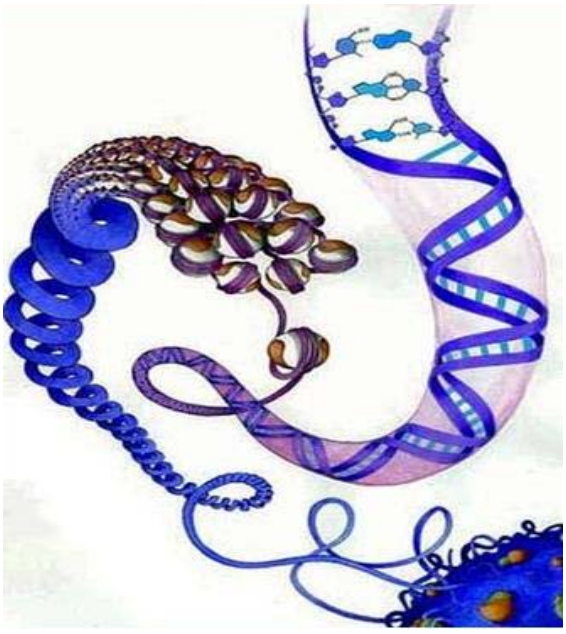
Nuclear Envelope- Function

- Nuclear envelope isolates the genetic information of eukaryotes in separate compartment.
- The pore complex regulates entry and exit of proteins and RNA and large complexes of macromolecules.

Nuclear lamina

A network array of protein filaments present at the nuclear side of the inner membrane. Nuclear lamina is absent at nuclear pore.

Nuclear lamina – function



- Maintain shape of nucleus.
- Organize genetic material.

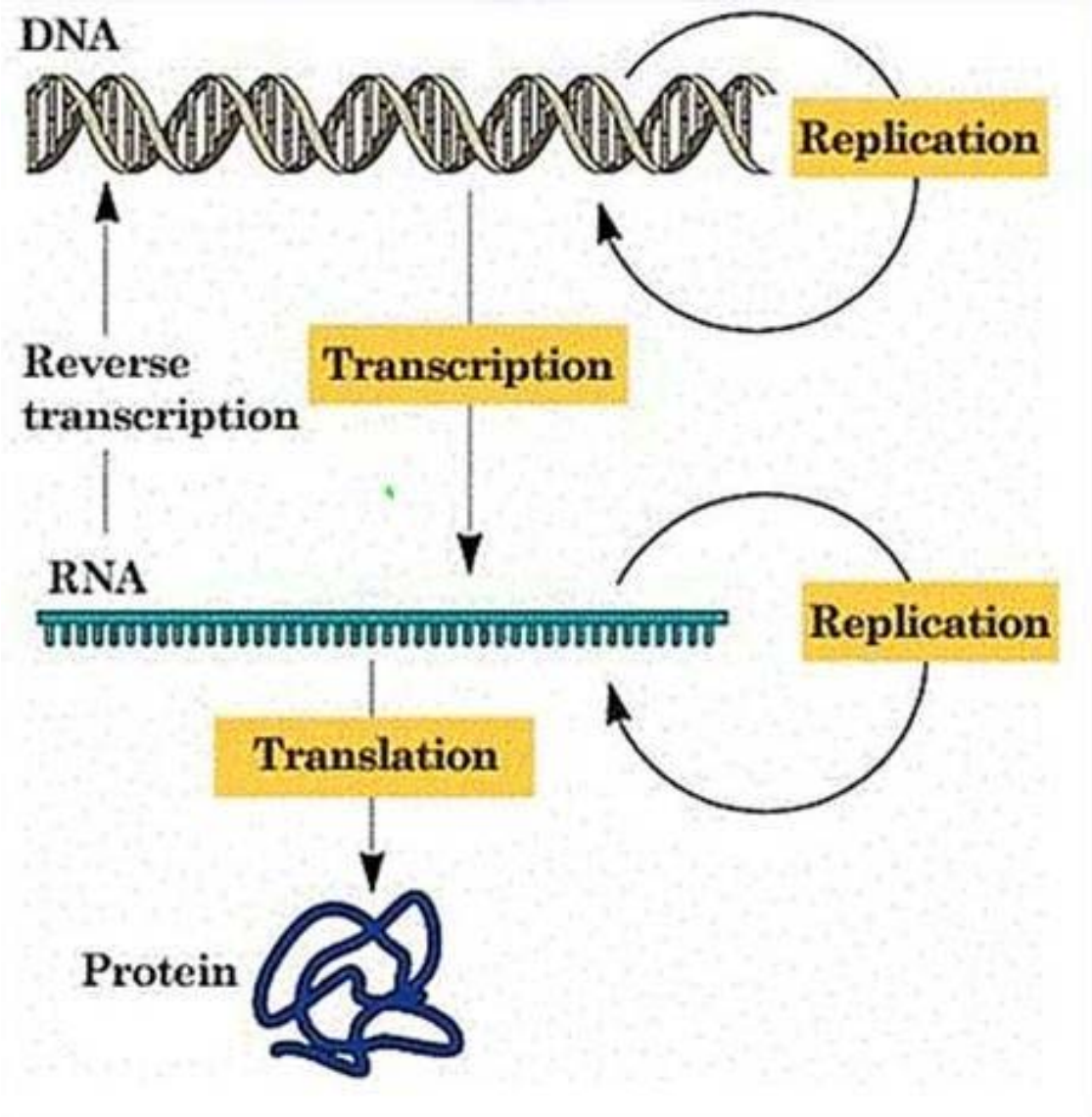
Genetic material-DNA

The DNA is complexed with basic proteins **histones** form chromatin material.

During cell division the chromatin material undergo condensation form chromosomes. There is **continuity between chromatin material and chromosomes.** At the time of cell division the chromatin material attain high levels of folding and forms chromosomes.

Central dogma

Central dogma was proposed by Crick. It states flow of genetic informations and also functional expression of these informations. The informations move from one generation of cells to second generation and from parents to progeny by **DNA replication**. For function expression the information contain in DNA flow in mRNA by the process of **transcription**. These informations in mRNA are used in translation of a specific protein. In retrovirus the RNA directs synthesis of DNA with the help of enzyme **reverse transcriptase**. The phenomenon was discovered by Temin and Baltimore hence also called **Teminism.**



Nucleolus

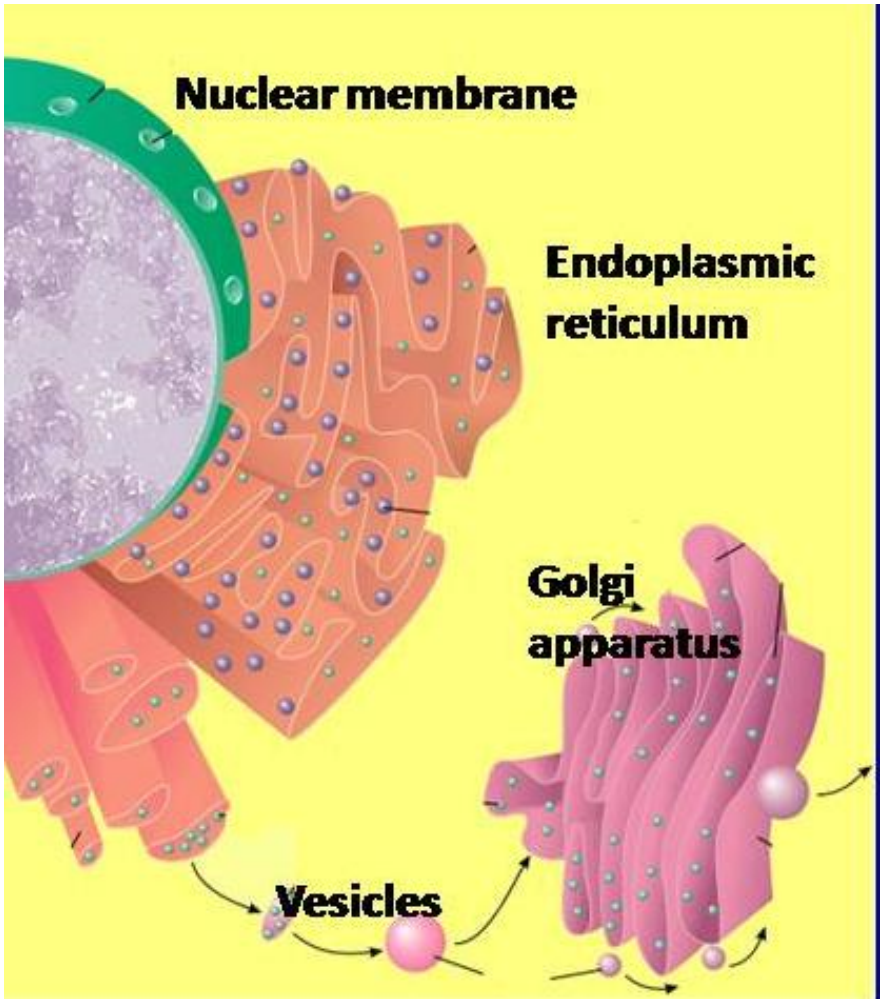
Nucleolus is seen in non dividing nucleus. This contains the genes for rRNA. Nucleolus is site of **ribosome biogenesis**.

Cytoplasm

Various components of eukaryotic cell are;

- Endomembrane system
- Energy transducer –Mitochondria, Chloroplast

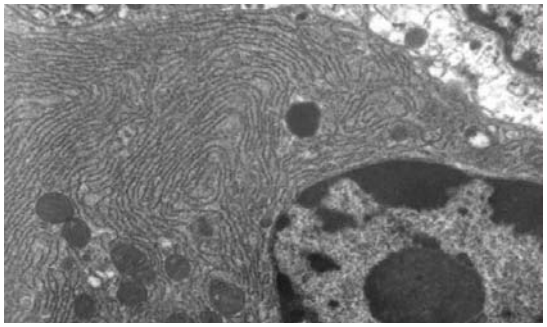
- Peroxisomes
- Vacuoles
- Ribosomes
- Cytoskeleton



Endomembrane system

The endomembrane system consists of **nuclear membrane, endoplasmic reticulum, Golgi complex, lysosomes ,and vesicles.**

The various components differ in their structure and function. These components are related either through direct continuity or by transfer of membrane segments as tiny vesicles.



- Smooth endoplasmic reticulum.

Endoplasmic reticulum

It consists of extensive **network of tubules and cisternae** distributed throughout the cytoplasm.

Endoplasmic reticulum is of two types:

- Rough endoplasmic reticulum

Rough endoplasmic reticulum

It has ribosomes attached to its outer surface. It functions in synthesis of secretary proteins.

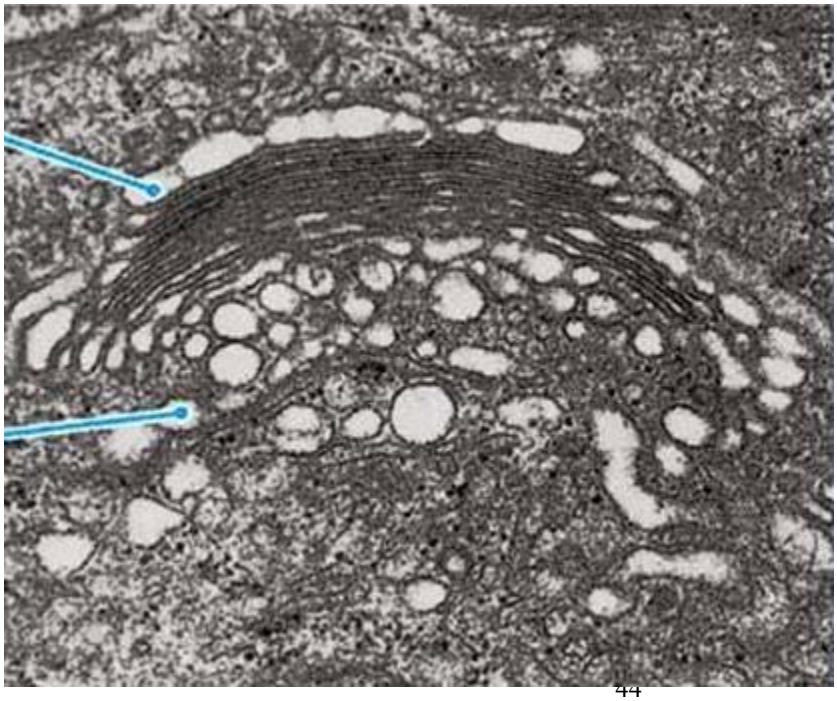
Smooth endoplasmic reticulum

It lacks ribosomes attached to its outer surface.

Functions

- Biosynthesis of lipids , phospholipids and steroids.
- Detoxification of drugs and toxins.
- Store Ca^{++} in muscle fibre.

Golgi apparatus



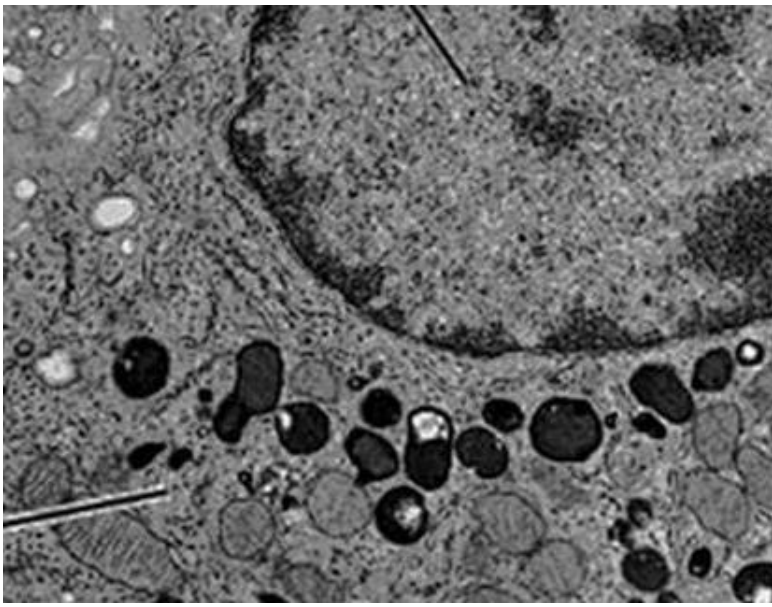
Golgi apparatus is centre of **manufacturing, warehousing, sorting and shipping of proteins.**

Morphology flattened sac **cisternae.**

Golgi apparatus exhibits **polarity** .**Cis** face or forming face near ER. **Trans** face or maturation face.

The products move from cis to trans face via transport vesicles. During this movement they are processed and modified.

Lysosome



Lysosomes are membranous sacs containing **acid hydrolase** enzymes. They exhibit **polymorphism**

Main function of lysosomes is **intracellular digestion**. The enzymes present in lysosomes can digest almost any macromolecules in acidic environment.

Lysosomes are also responsible for **autophagy** hence termed as **suicidal bag**.

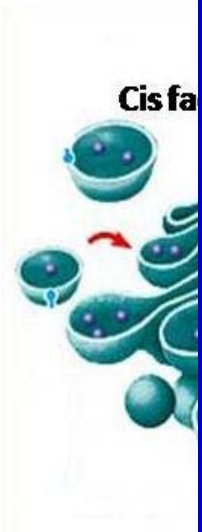
Lysosomes are associated with many developmental and physiological changes such as disappearance of tail during metamorphosis of frog.

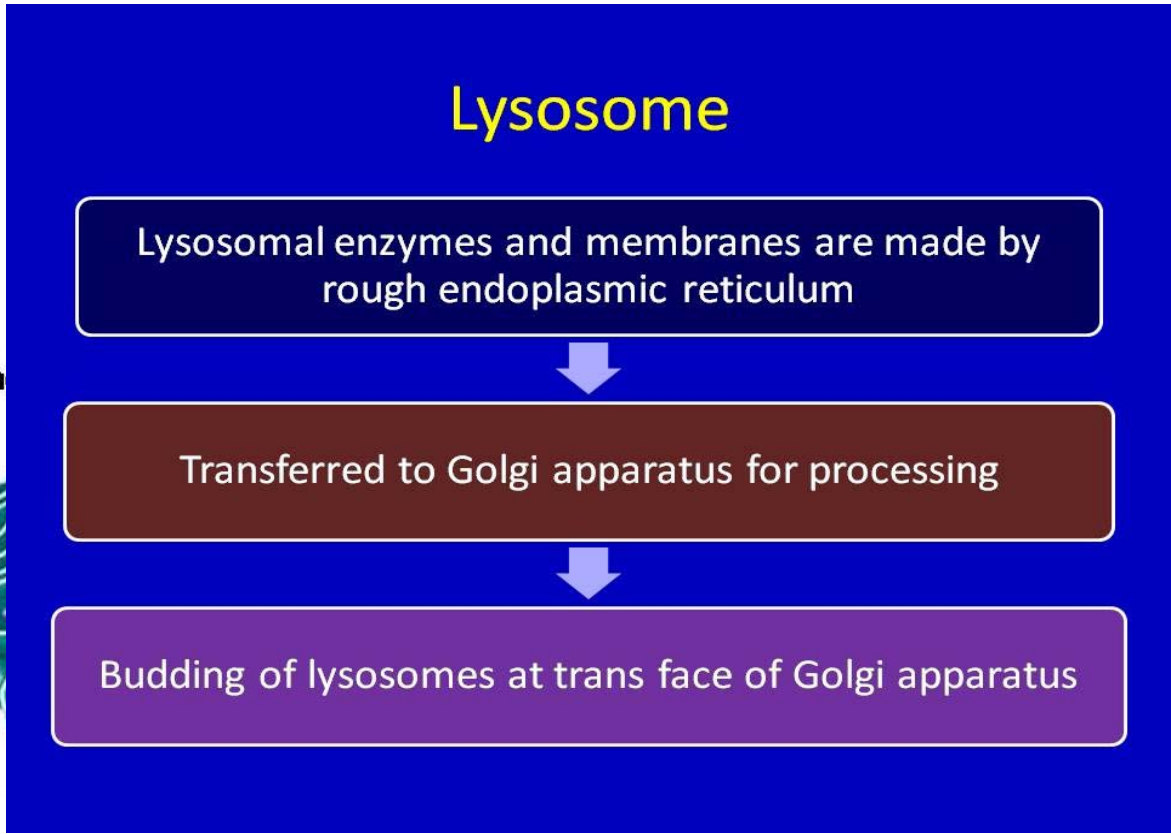
Lysosomes are responsible for chromosomal breaks and disease.

Biogenesis of lysosome

Lysosomal enzymes and membranes are made by rough endoplasmic reticulum,

transferred





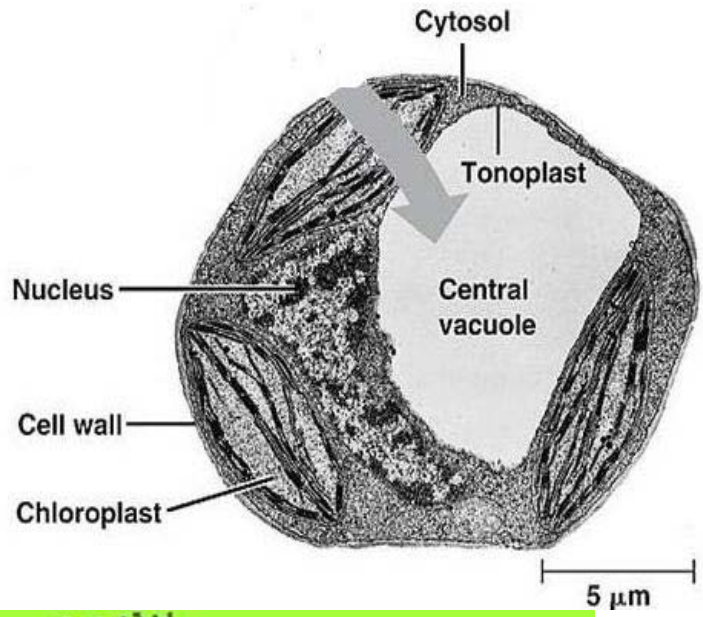
to Golgi apparatus for processing . Budding of lysosomes take at trans face of Golgi apparatus.

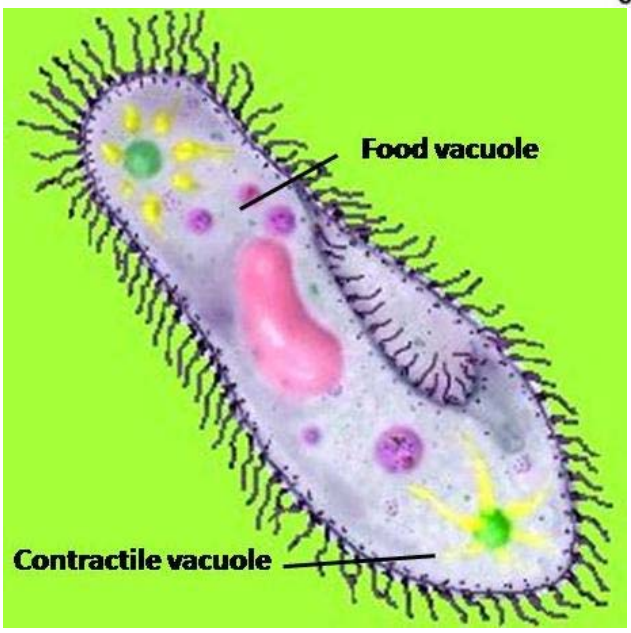
Vacuoles

Membrane bound vesicles with diverse functions are found in animal and plants.

In protozoa **food vacuole** and **contractile vacuole** are the common example.

In plant cells central vacuole is used for storage. Plant vacuole also contain hydrolytic enzymes hence function similar to lysosome in animal cell.



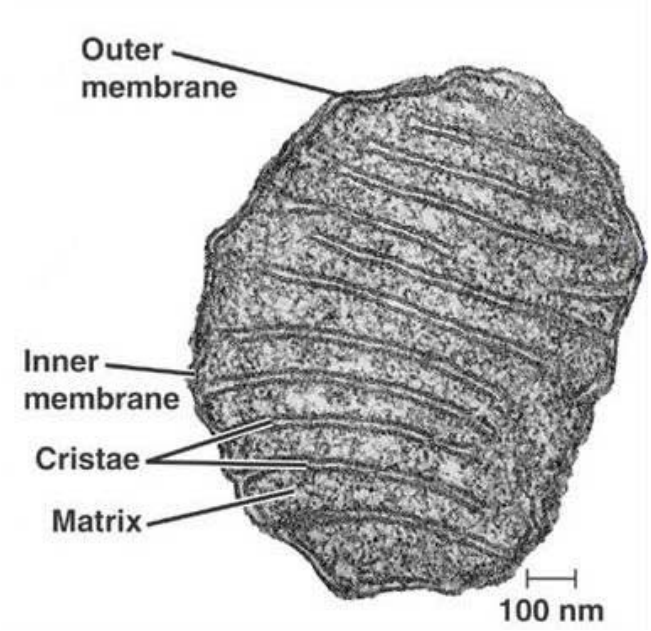


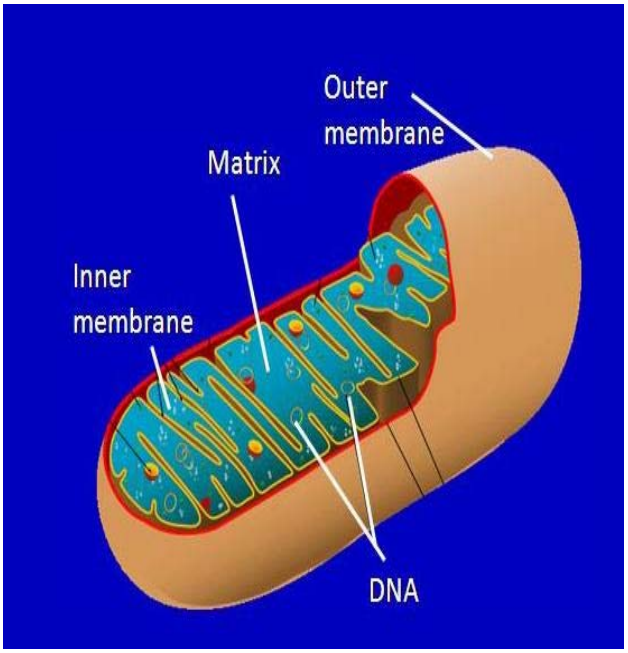
Mitochondria

Mitochondria are the site of **aerobic respiration** therefore termed as **power house** of the cell. Mitochondria are abundant in cell required steady supply of energy e.g. muscle cells.

Mitochondria -structure

Double membrane structure - outer membrane and inner membrane. The two membranes differ in structure, chemical composition and function. The two membrane enclosed a space called inter membrane space. The outer membrane is smooth while the inner membrane is projected into **infoldings called cristae** .The inner membrane contains **F1 particles**. The inner membrane enclosed matrix. Matrix contains circular DNA, ribosome and other components required for DNA replication and gene expression. Matrix also contains enzymes and coenzymes required for Krebs cycle.





Mitochondria- function

Cellular respiration

- Glycolysis - glucose is converted into pyruvate in the cytoplasm.
- Pyruvate is completely metabolized in mitochondria.
- Reactions involved

Krebs cycle

Electron transport chain

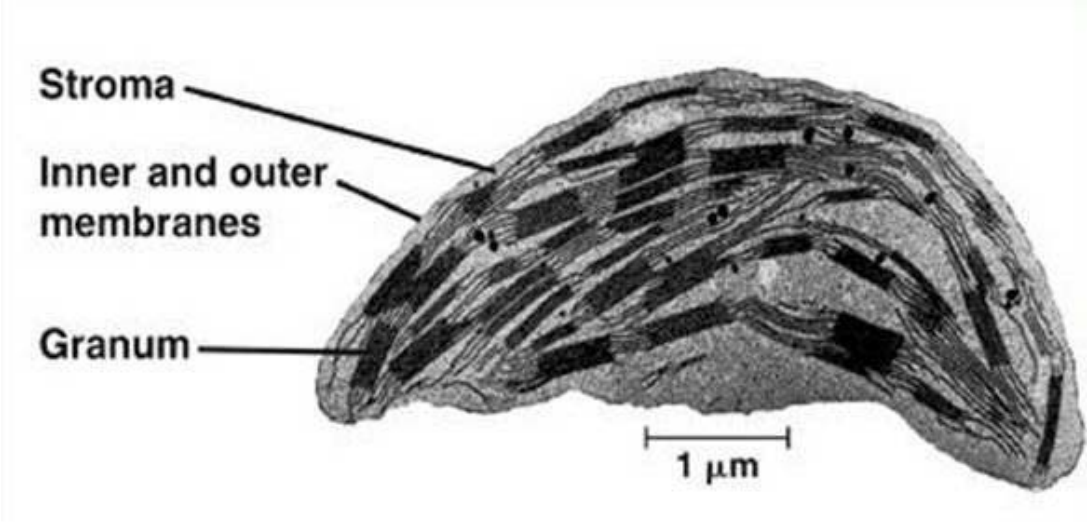
- The energy is generated in the form of ATP by the process of oxidative phosphorylation .
- In the reaction oxidation is coupled with phosphorylation .

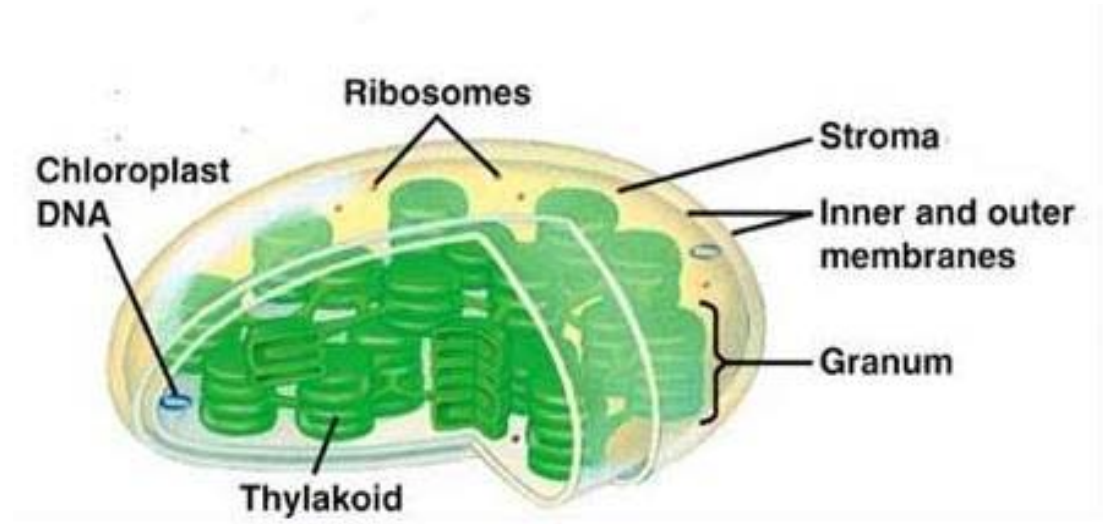
Mitochondria are **semiautonomous organelle**

Biogenesis of mitochondria requires information from two genetic systems. They contain complete genetic machinery. However the genetic system does not contain sufficient information for their independent multiplication therefore they depend partly on nuclear genome for their biogenesis.

Chloroplast

Chloroplast is site of photosynthesis. They are found in plant cells.





Chloroplast-Structure

Chloroplast is double membrane structure. The two membranes differ in structure, chemical composition and function. The inner membrane enclosed matrix. Matrix contains circular DNA, ribosome and other components required for DNA replication and gene expression. Matrix also contains enzymes and coenzymes required for photosynthesis.

Chloroplast –biogenesis

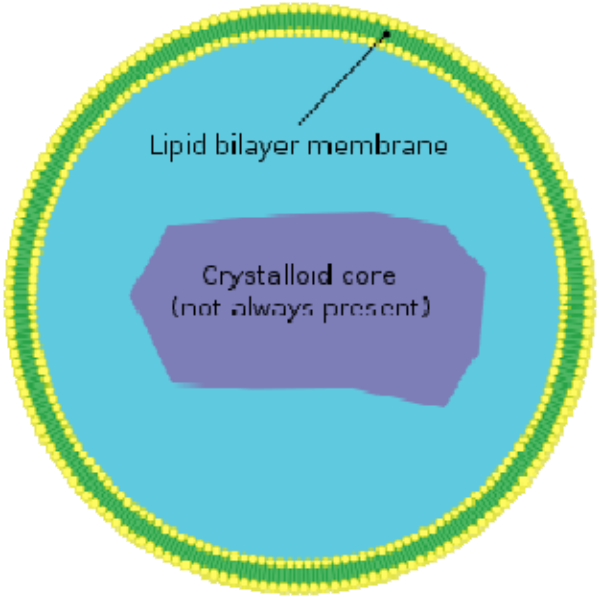
Chloroplast is **semiautonomous organelle**. Biogenesis of chloroplast requires information from two genetic systems.

Peroxisomes

Peroxisomes are membranous sacs. They contain the enzyme **peroxidase** and catalase. Peroxidase transfer hydrogen from various substrates to O_2 and produce H_2O_2.**Catalase** detoxify H_2O_2 into H_2O and O_2.

Peroxisome

From Wikipedia, the free encyclopedia



Basic structure of a peroxisome

Peroxisomes (also called **microbodies**) are organelles found in virtually all eukaryotic cells.[1] They are involved in the catabolism of very long chain fatty acids, branched chain fatty acids, D-amino acids, polyamines, and biosynthesis of plasmalogens, etherphospholipids critical for the normal function of mammalian brains and lungs.[2] They also contain approximately 10% of the total activity of two enzymes in the pentose phosphate pathway, which is important for energy metabolism.[2] It is vigorously debated if peroxisomes are involved in isoprenoid and cholesterol synthesis in animals.[2] Other known peroxisomal functions include the glyoxylate cycle in germinating seeds ("glyoxysomes"), photorespiration in leaves, glycolysis in trypanosomes ("glycosomes"), and methanol and/or amine oxidation and assimilation in some yeasts.

Peroxisomes were identified as organelles by the Belgian cytologist Christian de Duve in 1967[3] after they had been first described by a Swedish doctoral student, J. Rhodin in 1954.[4]

Contents

[hide]

[edit] Metabolic functions

A major function of the peroxisome is the breakdown of very long chain fatty acids through beta-oxidation. In animal cells, the very long fatty acids are converted to medium chain fatty acids, which are subsequently shuttled to mitochondria where they are eventually broken down to carbon dioxide and water.In yeast and plant cells, this process is exclusive for the peroxisomes.[5]

The first reactions in the formation of plasmalogen in animal cells also occur in peroxisomes. Plasmalogen is the most abundant phospholipid in myelin. Deficiency of plasmalogens causes profound abnormalities in the myelination of nerve cells, which is one reason why many peroxisomal disorders affect the nervous system.[6] However the last enzyme is absent in humans, explaining the disease known as gout, caused by the accumulation of uric acid. Certain enzymes within the peroxisome, by using molecular oxygen, remove hydrogen atoms from specific organic substrates (labeled as R), in an oxidative reaction, producing hydrogen peroxide (H_2O_2, itself toxic):

$$RH_2 + O_2 \rightarrow R + H_2O_2$$

peroxidase, another peroxisomal enzyme, uses this H_2O_2 to oxidize other substrates, including phenols, formic acid, formaldehyde, and alcohol, by means of the peroxidation reaction:

$H_2O_2 + R'H_2 \rightarrow R' + 2H_2O$, thus eliminating the poisonous hydrogen peroxide in the process.

This reaction is important in liver and kidney cells, where the peroxisomes detoxify various toxic substances that enter the blood. About 25% of the ethanol humans drink is oxidized to acetaldehyde in this way.[*citation needed*] In addition, when excess H_2O_2 accumulates in the cell, catalase converts it to H_2O through this reaction:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

In higher plants, peroxisomes contain also a complex battery of antioxidative enzymes such as superoxide dismutase, the components of the ascorbate-glutathione cycle, and the NADP-dehydrogenases of the pentose-phosphate pathway. It has been demonstrated the generation of superoxide ($O_2^{\bullet-}$) and nitric oxide ($^{\bullet}NO$) radicals.[7][8]

The peroxisome of plant cells is polarised when fighting fungal penetration. Infection causes a glucosinolate molecule to play an antifungal role to be made and delivered to the outside of the cell through the action of the peroxisomal proteins (PEN2 and PEN3).[9]

[edit] Peroxisome assembly

Peroxisomes can be derived from the endoplasmic reticulum and replicate by fission.[10] Peroxisome matrix proteins are translated in the cytoplasm prior to import. Specific amino acid sequences (PTS or peroxisomal targeting signal) at the *C-terminus* (PTS1) or *N-terminus* (PTS2) of peroxisomal matrix proteins signals them to be imported into the organelle. There are at least 32 known peroxisomal proteins, called peroxins,[11] which participate in the process of peroxisome assembly. Proteins do not have to unfold to be imported into the peroxisome. The protein receptors, the peroxins *PEX5* and *PEX7*, accompany their cargoes (containing a PTS1 or a PTS5 amino acid sequence, respectively) all the way into the peroxisome where they release the cargo and then return to the cytosol - a step named *recycling*. A model describing the import cycle is referred to as the *extended shuttle mechanism*.[12] There is now evidence that ATP hydrolysis is required for the recycling of receptors to the cytosol. Also, ubiquitination appears to be crucial for the export of PEX5 from the peroxisome, to the cytosol.

[edit] Associated medical conditions

Peroxisomal disorders are a class of medical conditions that typically affect the human nervous system as well as many other organ systems. Two common examples are X-linked adrenoleukodystrophy and peroxisome biogenesis disorders.[13][14]

[edit] Genes

PEX genes encode the protein machinery ("peroxins") required for proper peroxisome assembly, as described above. Membrane assembly and maintenance requires three of these (peroxins 3, 16, and 19) and may occur without the import of the matrix (lumen) enzymes. Proliferation of the organelle is regulated by Pex11p.

Genes that encode peroxin proteins include: PEX1, PEX2 - PXMP3, PEX3, PEX5, PEX6, PEX7, PEX10, PEX11A, PEX11B, PEX11G, PEX12, PEX13, PEX14, PEX16, PEX19, PEX26, PEX28, PEX30, and PEX31

[edit] Evolutionary origins

The protein content of peroxisomes varies across species, but the presence of proteins common to many species has been used to suggest an endosymbiotic origin; that is, peroxisomes evolved from bacteria that invaded larger cells as parasites, and very gradually evolved a symbiotic relationship.[15] However, this view has been challenged by recent discoveries.[16] For example, peroxisome-less mutants can restore peroxisomes upon introduction of the wild-type gene.

Two independent evolutionary analyses of the peroxisomal proteome found homologies between the peroxisomal import machinery and the ERAD pathway in the endoplasmic reticulum,[17][18] along with a number of metabolic enzymes that were likely recruited from the mitochondria.[18] Recently, it has been suggested that the peroxisome may have had an actinobacterial origin,[19] however, this is controversial.[20]

[edit] Other related organelles

Other organelles of the microbody family related to peroxisomes include glyoxysomes of plants and filamentous fungi, glycosomes of kinetoplastids[21] and Woronin bodies of filamentous fungi.

Peroxisomes

Peroxisomes are about the size of lysosomes (0.5–1.5 µm) and like them are enclosed by a single membrane. They also resemble lysosomes in being filled with enzymes.

However, peroxisomes bud off from the endoplasmic reticulum, not the Golgi apparatus (that is the source of lysosomes).

The enzymes and other proteins destined for peroxisomes are synthesized in the cytosol. Each contains a **p**eroxisomal **t**argeting **s**ignal (**PTS**) that binds to a receptor molecule that takes the protein into the peroxisome and then returns for another load.

Two peroxisomal targeting signals have been identified:

- a 9-amino acid sequence at the N-terminal of the protein;
- a tripeptide at the C-terminal.

Each has its own receptor to take it to the peroxisome.

Some of the functions of the peroxisomes in the human liver:

- Breakdown (by oxidation) of excess fatty acids.
- Breakdown of hydrogen peroxide (H_2O_2), a potentially dangerous product of fatty-acid oxidation. It is catalyzed by the enzyme **catalase**. [Link to further discussion]
- Participates in the synthesis of cholesterol. One of the enzymes involved, HMG-CoA reductase, is the target of the popular cholesterol-lowering "statins".
- Participates in the synthesis of bile acids.
- Participates in the synthesis of the lipids used to make myelin.
- Breakdown of excess purines (AMP, GMP) to uric acid.

Peroxisomes are also present in **plant** cells where they participate is such functions as

- symbiotic nitrogen fixation
- photorespiration

Peroxisome Disorders

A variety of rare inherited disorders of peroxisome function occur in humans.

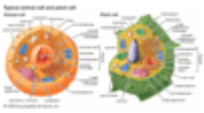
- Most involve mutant versions of one or another of the enzymes found within peroxisomes.

  Example: **X-linked adrenoleukodystrophy** (**X-ALD**). This disorder results from a failure to metabolize fatty acids properly. One result is deterioration of the myelin sheaths of neurons. The disorder occurs in young boys because the gene is X-linked. An attempt to find an effective treatment was the subject of the 1992 film **Lorenzo's Oil**.

- A few diseases result from failure to produce functional peroxisomes.

Example: **Zellweger syndrome**. This disorder results from the inheritance of two mutant genes for one of the receptors (PXR1) needed to import proteins into the peroxisome.

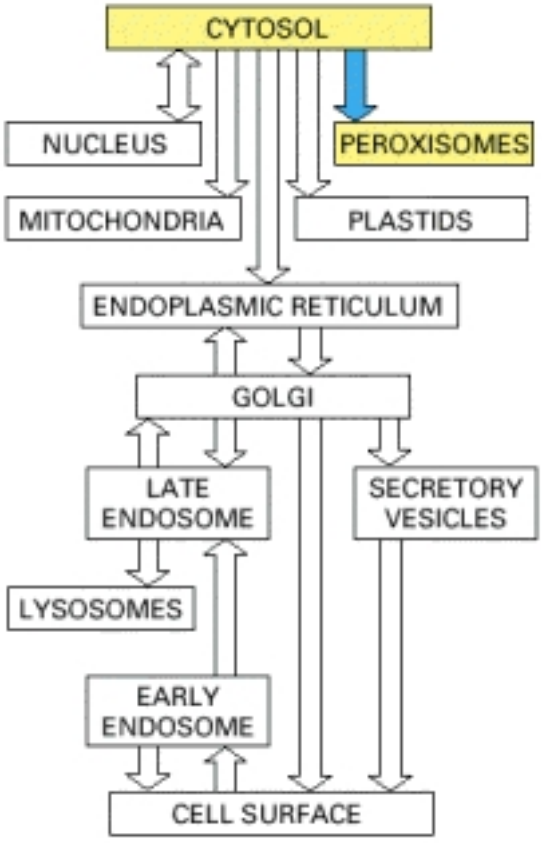
Peroxisomes are also called **microbodies**.



peroxisome, membrane-bound organelle occurring in the cytoplasm of eukaryotic cells. Peroxisomes contain enzymes that oxidize certain molecules normally found in the cell, notably fatty acids and amino acids. These oxidation reactions produce hydrogen peroxide, which is the basis of the name *peroxisome*. However, hydrogen peroxide is potentially toxic to the cell, because it has the ability to react with many other molecules. Therefore, peroxisomes also contain enzymes such as catalase that convert hydrogen peroxide to water and oxygen, thereby neutralizing the toxicity. In this way peroxisomes provide a safe location for the oxidative metabolism of certain molecules.

Peroxisomes

Peroxisomes differ from mitochondria and chloroplasts in many ways. Most notably, they are surrounded by only a single membrane, and they do not contain DNA or ribosomes. Like mitochondria and chloroplasts, however, peroxisomes are thought to acquire their proteins by selective import from the cytosol. But because they have no genome, *all* of their proteins must be imported. Peroxisomes thus resemble the ER in being a self-replicating, membrane-enclosed organelle that exists without a genome of its own.



Because we do not discuss peroxisomes elsewhere, we shall digress to consider some of the functions of this diverse family of organelles, before discussing their biosynthesis. Peroxisomes are found in all eucaryotic cells. They contain oxidative enzymes, such as *catalase* and *urate*

oxidase, at such high concentrations that in some cells the peroxisomes stand out in electron micrographs because of the presence of a crystalloid core (Figure 12-31).

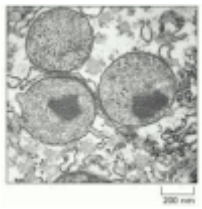


Figure 12-31

An electron micrograph of three peroxisomes in a rat liver cell. The paracrystalline electron-dense inclusions are composed of the enzyme urate oxidase. (Courtesy of Daniel S. Friend.)

Like mitochondria, peroxisomes are major sites of oxygen utilization. One hypothesis is that peroxisomes are a vestige of an ancient organelle that performed all the oxygen metabolism in the primitive ancestors of eucaryotic cells. When the oxygen produced by photosynthetic bacteria first began to accumulate in the atmosphere, it would have been highly toxic to most cells. Peroxisomes might have served to lower the intracellular concentration of oxygen, while also exploiting its chemical reactivity to perform useful oxidative reactions. According to this view, the later development of mitochondria rendered peroxisomes largely obsolete because many of the same reactions—which had formerly been carried out in peroxisomes without producing energy—were now coupled to ATP formation by means of oxidative phosphorylation. The oxidative reactions performed by peroxisomes in present-day cells would therefore be those that have important functions not taken over by mitochondria.

Peroxisomes Use Molecular Oxygen and Hydrogen Peroxide to Perform Oxidative Reactions

Go to:

Peroxisomes are so named because they usually contain one or more enzymes that use molecular oxygen to remove hydrogen atoms from specific organic substrates (designated here as R) in an oxidative reaction that produces *hydrogen peroxide (H_2O_2)*:

$$RH_2 + O_2 \rightarrow R + H_2O_2$$

Catalase utilizes the H_2O_2 generated by other enzymes in the organelle to oxidize a variety of other substrates—including phenols, formic acid, formaldehyde, and alcohol—by the "peroxidative" reaction: $H_2O_2 + R'H_2 \rightarrow R' + 2H_2O$. This type of oxidative reaction is particularly important in liver and kidney cells, where the peroxisomes detoxify various toxic molecules that enter the bloodstream. About 25% of the ethanol we drink is oxidized to acetaldehyde in this way. In addition, when excess H_2O_2 accumulates in the cell, catalase converts it to H_2O through the reaction:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

A major function of the oxidative reactions performed in peroxisomes is the breakdown of fatty acid molecules. In a process called *β oxidation*, the alkyl chains of fatty acids are shortened sequentially by blocks of two carbon atoms at a time, thereby converting the fatty acids to acetyl CoA. The acetyl CoA is then exported from the peroxisomes to the cytosol for reuse in biosynthetic reactions. In mammalian cells, β oxidation occurs in both mitochondria and

peroxisomes; in yeast and plant cells, however, this essential reaction occurs exclusively in peroxisomes.

An essential biosynthetic function of animal peroxisomes is to catalyze the first reactions in the formation of *plasmalogens*, which are the most abundant class of phospholipids in myelin (Figure 12-32). Deficiency of plasmalogens causes profound abnormalities in the myelination of nerve cells, which is one reason why many peroxisomal disorders lead to neurological disease.

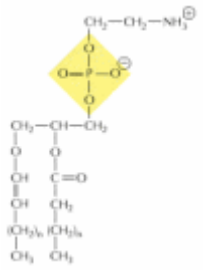


Figure 12-32

The structure of a plasmalogen. Plasmalogens are very abundant in the myelin sheaths that insulate the axons of nerve cells. They make up some 80–90% of the myelin membrane phospholipids. In addition to an ethanolamine head group and a long-chain (more...)

Peroxisomes are unusually diverse organelles, and even in the various cell types of a single organism they may contain different sets of enzymes. They can also adapt remarkably to changing conditions. Yeast cells grown on sugar, for example, have small peroxisomes. But when some yeasts are grown on methanol, they develop large peroxisomes that oxidize methanol; and when grown on fatty acids, they develop large peroxisomes that break down fatty acids to acetyl CoA by β oxidation.

Peroxisomes are also important in plants. Two different types have been studied extensively. One type is present in leaves, where it catalyzes the oxidation of a side product of the crucial reaction that fixes CO_2 in carbohydrate (Figure 12-33A). As discussed in Chapter 14, this process is called *photorespiration* because it uses up O_2 and liberates CO_2. The other type of peroxisome is present in germinating seeds, where it has an essential role in converting the fatty acids stored in seed lipids into the sugars needed for the growth of the young plant. Because this conversion of fats to sugars is accomplished by a series of reactions known as the *glyoxylate cycle*, these peroxisomes are also called *glyoxysomes* (Figure 12-33B). In the glyoxylate cycle, two molecules of acetyl CoA produced by fatty acid breakdown in the peroxisome are used to make succinic acid, which then leaves the peroxisome and is converted into glucose. The glyoxylate cycle does not occur in animal cells, and animals are therefore unable to convert the fatty acids in fats into carbohydrates.

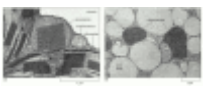


Figure 12-33

Electron micrographs of two types of peroxisomes found in plant cells. (A) A peroxisome with a paracrystalline core in a tobacco leaf mesophyll cell. Its close association with chloroplasts is thought to facilitate the exchange of materials between these (more...)

A Short Signal Sequence Directs the Import of Proteins into Peroxisomes

Go to:

A specific sequence of three amino acids located at the C terminus of many peroxisomal proteins functions as an import signal (see Table 12-3). Other peroxisomal proteins contain a signal sequence near the N terminus. If either of these sequences is experimentally attached to a cytosolic protein, the protein is imported into peroxisomes. The import process is still poorly understood, although it is known to involve soluble receptor proteins in the cytosol that recognize the targeting signals, as well as docking proteins on the cytosolic surface of the peroxisome. At least 23 distinct proteins, called **peroxins**, participate as components in the process, which is driven by ATP hydrolysis. Oligomeric proteins do not have to unfold to be imported into peroxisomes, indicating that the mechanism is distinct from that used by mitochondria and chloroplasts and at least one soluble import receptor, the peroxin Pex5, accompanies its cargo all the way into peroxisomes and, after cargo release, cycles back out into the cytosol. These aspects of peroxisomal protein import resemble protein tranport into the nucleus.

The importance of this import process and of peroxisomes is demonstrated by the inherited human disease *Zellweger syndrome,* in which a defect in importing proteins into peroxisomes leads to a severe peroxisomal deficiency. These individuals, whose cells contain "empty" peroxisomes, have severe abnormalities in their brain, liver, and kidneys, and they die soon after birth. One form of this disease has been shown to be due to a mutation in the gene encoding a peroxisomal integral membrane protein, the peroxin Pex2, involved in protein import. A milder inherited peroxisomal disease is caused by a defective receptor for the N-terminal import signal.

Most peroxisomal membrane proteins are made in the cytosol and then insert into the membrane of preexisting peroxisomes. Thus, new peroxisomes are thought to arise from preexisting ones, by organelle growth and fission—as mentioned earlier for mitochondria and plastids, and as we describe below for the ER (Figure 12-34).

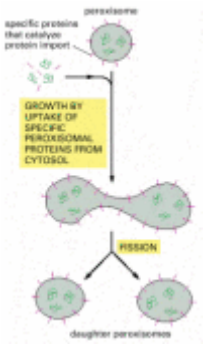


Figure 12-34

A model for how new peroxisomes are produced. The peroxisome membrane contains import receptor proteins. Peroxisomal proteins, including new copies of the import receptor, are synthesized by cytosolic ribosomes and then imported into the organelle. Presumably, (more...)

Summary

Go to:

Peroxisomes are specialized for carrying out oxidative reactions using molecular oxygen. They generate hydrogen peroxide, which they use for oxidative purposes—destroying the excess by means of the catalase they contain. Peroxisomes also have an important role in the synthesis of specialized phospholipids required for nerve cell myelination. Like mitochondria and plastids, peroxisomes are thought to be self-replicating organelles. Because they contain no DNA or ribosomes, however, they have to import their proteins from the cytosol. A specific sequence of three amino acids near the C terminus of many of these proteins functions as a peroxisomal import signal. The mechanism of protein import is distinct from that of mitochondria and chloroplasts, and oligomeric proteins can be transported into peroxisomes without unfolding.

The Peroxisomal Disorders

DISCLAIMER: The purpose of this page is to sketch, in a general and non-technical manner, the current state of knowledge on the nature and functions of the peroxisome, and the diseases resulting from peroxisomal dysfunction. This information is drawn from a range of medical literature, and is intended to reflect areas in which there is prevailing consensus of opinion. It is believed that the concepts and models discussed represent the best available, and most widely accepted, understanding of the subject.

The author of this page has no medical background and the content is targeted toward a similar readership, typically the parents of affected children. I hope that it may also be of some benefit to health care workers who are not specialists in the field and other professionals working with these children.

HOWEVER, it is hereby expressly stated that the following discussion is NOT to be considered medical advice, or as having any particular relevance to any particular case, or as representing all possible schools of thought. In particular, the subjects of therapy and diet are not within its scope, except in passing mention. IT'S REAL SIMPLE: If you need medical advice you need to be consulting with a physician. Go. Now. We'll still be here.

OVERVIEW

The peroxisome is one of several types of organelles present in almost all eukaryotic cells (cells having a nucleus), both plant and animal, an organelle being a specialized structure within a cell where particular chemical and metabolic functions take place. Close metabolic interrelationships exist between the peroxisomes and the other organelles of the cell, the chemical result of one organelle's process often being the raw material of the next. The precise means by which these transports occur is not fully understood; it is surmised from the chemistry involved, but usually not accessible to direct observation. This is true for much of the understanding of the peroxisomes.

A peroxisome is a round or oval body with an average diameter of 0.5 micron. A cell will contain not one, or even several, peroxisomes but possibly several hundred. The peroxisome is bound by a membrane composed of lipids and proteins, and its interior (called the matrix) is made up of various proteins which function as enzymes in metabolic processes.

Peroxisomes are especially abundant, and larger in size, in the cells that make up the liver and kidneys of humans and other mammals. Although all peroxisomes are biochemically active, those in liver and kidney perform the majority of peroxisomal function. In a developing fetus and (in humans) for a few weeks after birth, peroxisomes are also abundant in the oligodendrocytes, the cells which surround the developing central nervous system, act to guide its growth, and synthesize the myelin sheath which insulates it.

The peroxisome was "discovered" in 1954 by a doctor named Rhodin, and over the next ten years some of its more basic functions were determined. This was in large part the work of another doctor named de Duve. The name peroxisome derives from the early observation of the role of this organelle in cellular respiration, a process involving both the generation and decomposition of hydrogen peroxide. Catalase, the enzyme which breaks down hydrogen peroxide, is the necessary identifying marker of the peroxisome: by definition, a peroxisome must contain it and a subcellular structure not containing catalase is not considered a peroxisome.

It is now known that approximately fifty different biochemical reactions occur entirely or partially within the peroxisome. Some of the processes are anabolic, meaning constructive, and

lead to the synthesis of essential biochemicals: bile acids, cholesterol, ether-phospholipids (plasmologens), and docosahexaenoic acid. Some of the processes are catabolic, meaning destructive, and lead to the decomposition of certain fatty acids, particularly very long chain fatty acids (VLCFAs) and others such as phytanic acid, pipecolic acid, and the prostaglandins. Most of these processes involve coordinated interactions between the peroxisomes and other organelles, and each metabolic step is dependent upon the successful completion of the previous. For example, the decomposition of the VCLFAs and phytanic acid is a process shared by the peroxisomes and the mitochondria, the correct functioning of the peroxisomal steps being essential to the overall success of the process. Likewise, the final steps in the synthesis of the plasmologens occur in the endoplasmic reticulum, but the process depends on precursors which are synthesized in the peroxisomes.

PEROXISOMAL BIOGENESIS

A peroxisome doesn't last very long. Its "life span" is just a day or two, so there has to be a constant process of replacement, the formation of new peroxisomes. This process, referred to as peroxisomal biogenesis or peroxisomal assembly, goes like this:
1) The proteins which will make up the peroxisome's membrane and matrix are synthesized by free ribosomes, another type of organelle. The ribosome is the site at which messenger RNA, bringing genetic information from the DNA in the cell nucleus, is translated into the variety of proteins which make up the cell and its organelles. (Some organelles, notably the mitochondria, also contain their own DNA and ability to synthesize some proteins internally. This has led to the hypothesis that the mitochondria (and possibly also the peroxisomes, which however do not contain their own DNA) were originally independent life forms that have evolved into a complex symbiosis with their host, the cell. At any rate, the vast majority of the proteins necessary to the cell and its organelles are synthesized on the ribosomes from nuclear genetic coding.)
2) The completed proteins enter the cytosol, which is (roughly speaking) that portion of the cell's interior that isn't either the nucleus or an organelle.
3) From the cytosol, the peroxisomal membrane and matrix proteins are imported into pre-existing peroxisomes, which exist either singly or in a network called a peroxisomal reticulum. These expand with the upload of the new material and at a certain point new peroxisomes are formed either by division or budding from the reticulum.

The various proteins are directed to their correct positions in the peroxisome - either incorporated into the membrane or passing through it into the matrix - by means of peroxisomal targeting signals (PTSs). A PTS is a sequence of amino acids usually at or near an end of the protein, synthesized along with it on the ribosome. This sequence is not properly a part of the actual protein but is a tag essentially identifying it to a second protein known as a PTS receptor. A PTS receptor is a mobile protein which repeatedly shuttles between the cytsol - recognizing and binding the PTS protein - and the peroxisome, separating from it and leaving it for import.

About half of the peroxisomal matrix proteins are identified by a sequence known as PTS1 (SKL, serine-lysine-leucine, or certain variants), and several more by a sequence known as PTS2, occuring at opposite ends of the protein. There are also proteins which have both the PTS1 and PTS2. Other known matrix proteins have neither the PTS1 nor the PTS2, so it is assumed that there must also be a PTS3 and possibly others, trickier to identify as they don't occur at the ends of the protein, but internally. The proteins which are components of the peroxisomal membrane (integral membrane proteins, IMP) also have a type of internal PTS.

The receptors for PTS1 and PTS2 have been closely studied, both the functioning proteins and the genes which code for them. Their role in peroxisome biogenesis is well-understood, and there is known correlation between mutuations of these genes and some of the peroxisomal diseases, the biogenesis disorders.

There are about fifteen other proteins known to be necessary to the correct assembly of a peroxisome. For the most part the genes which code for them have been identified, although the exact function of the protein may be only more or less understood. In addition to the PTS1 and

PTS2 receptors (and presumably the PTS3 receptor not yet identified), there are proteins known as chaperones (heat shock proteins) which go along for the shuttle ride and somehow mediate between the PTS-protein and the PTS-receptor. Others known as gatekeepers are possibly involved in the separation of the protein from the receptor. There are integral membrane proteins which serve as the docking sites for the receptors and their cargos, and also as the passageways by which the proteins enter the matrix. There are proteins which regulate the numbers of peroxisomes within a cell, and still others which regulate the distribution of peroxisomes at the time of cell division.

Collectively, these proteins - the ones involved in peroxisome biogenesis, as distinct from the matrix enzyme proteins involved in peroxisomal function - are known as peroxins. These proteins, and the genes which code for them, are known by the acronym PEX and they are numbered PEX1, PEX2, &c. in the order of their original published descriptions. For instance, PEX5 is the gene which codes for the PTS1 receptor, and PEX7 is the gene which codes for the PTS2 receptor. By no means is the nuts and bolts operation of the targeting signals and the peroxins completely understood or agreed upon. Much of it is downright mysterious. But aside from a number of technical questions (as, for example, whether the receptors uncouple from their proteins at the peroxisome's surface or if this happens in the peroxisome's interior) which are under specialized and on-going investigation, the basic model of peroxisome assembly is pretty much accepted. Much of this knowledge has been gained by the study of certain yeasts. There is an almost complete genetic and chemical identity between peroxisome assembly in these yeasts and in humans, so that understanding the gene mutations in the yeast peroxins is directly applicable to understanding the human peroxisome biogenesis disorders.

Peroxisome Biogenesis

Peroxisomes play important roles in cellular metabolism by oxidizing fatty acids, bile salts and cholesterol and by converting hydrogen peroxide to nontoxic forms, but where peroxisomes originate from has been unclear. The long-standing view has been that peroxisomes are semiautonomous oranelles, like mitochondria, which multiply strictly by growth and division. That most peroxisomal proteins are synthesized on free ribosomes and are imported directly into peroxisomes from the cytoplasm supports this view. However, peroxisomes can disappear from a cell and then be regenerated de novo, unlike mitochondria. This regenerative capacity has led to an alternative view in which other organelles- such as ER- participate in the formation and maintenance of peroxisomal membranes.

Our work with peroxisomes has been aimed at addressing whether the ER plays a role in peroxisomal biogenesis in mammalian cells, and if so, how this is regulated. Towards this goal, we have used diverse live cell fluorescent labeling strategies, including photoactivation, to pulse-label peroxisomal components (including the early event peroxin, PEX16) and to follow their targeting to peroxisomes. Evidence favoring an ER origin of peroxisomal membranes came from our finding that when the ER pool of PEX16-PAGFP was photoactivated and followed over time, the photoactivated molecules redistributed to peroxisomes (Kim et al., JCB, 2006). To test what role this ER-to-peroxisome pathway plays in the normal proliferation of peroxisomes during the cell cycle, we employed a photo-labeling, pulse-chase strategy for distinguishing newly synthesized from previously synthesized peroxisomal protein components and for visualizing both old and new peroxisomes. We found that old peroxisomes contained both newly

synthesized and previously synthesized protein components, whereas new peroxisomes contained only newly synthesized peroxisomal protein components (Kim et al., JCB, 2006). This argued against fission being the predominant mechanism for mammalian peroxisome formation and indicated that de novo biogenesis of peroxisomes from the ER was important for maintenance of peroxisomes under normal conditions.

These results have helped solidify the view that peroxisomes are derived from the ER and have provided insight into how peroxisomes proliferate and are maintained within mammalian cells. Ongoing work in the lab is aimed at using the new live cell imaging strategies to investigate how peroxisome proliferation is regulated in response to drugs and other physiological conditions. We are also investigating how peroxisomes are turned over within cells and the mechanism(s) for uptake of soluble proteins into these organelles.

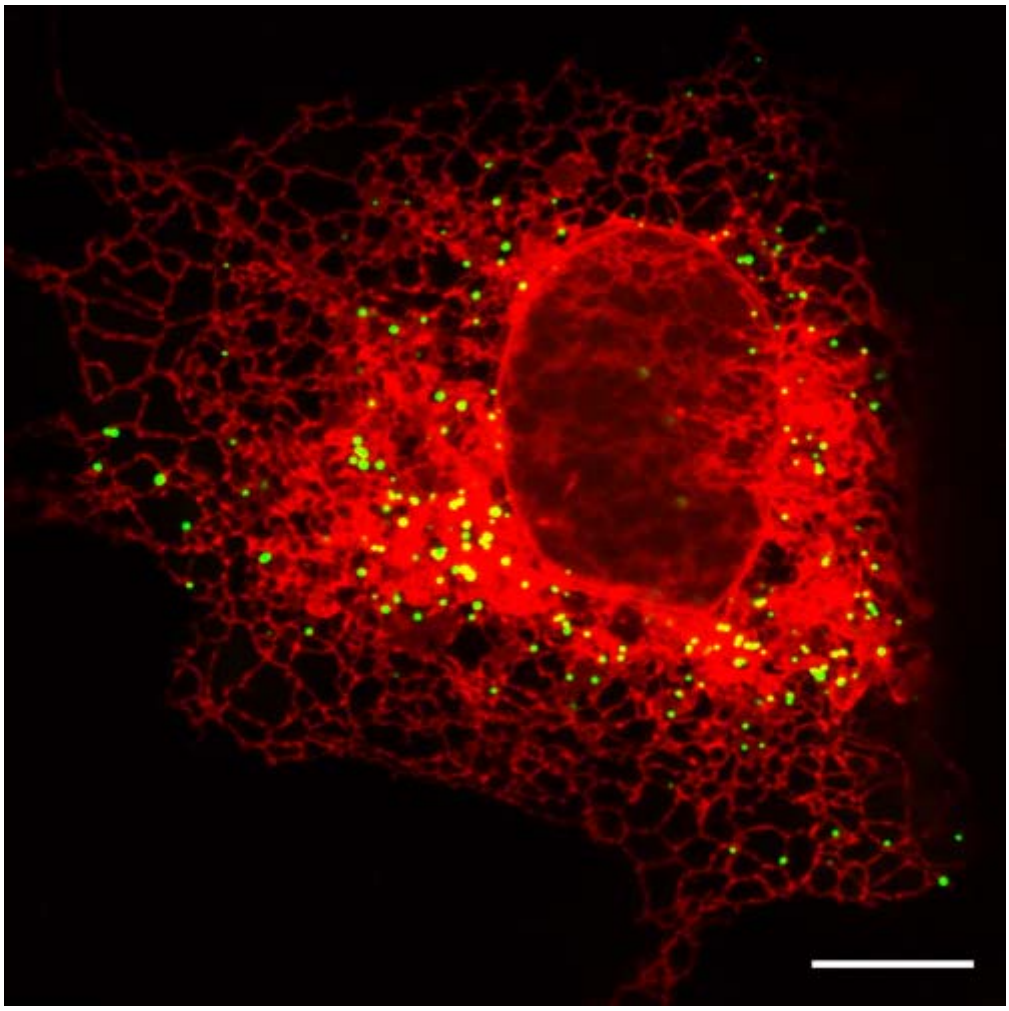
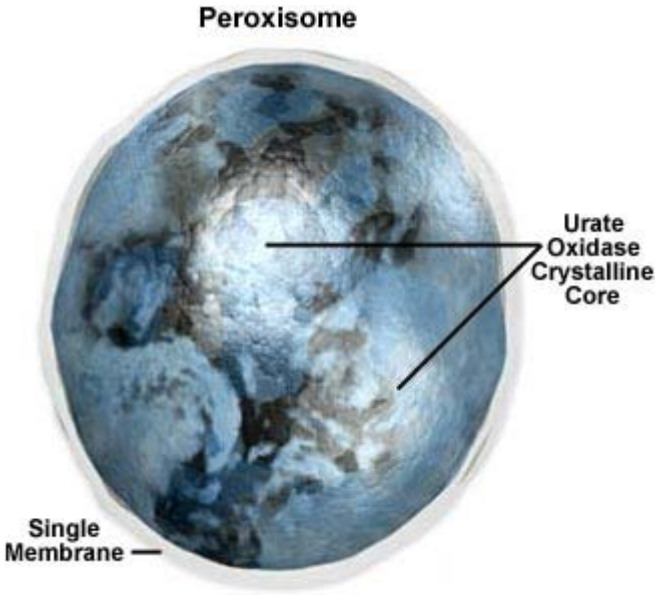


Figure: COS 7 cell expressing an ER marker (red: ssRFPKDEL) and a peroxisomal marker (green: mGFP-SKL). The image is a projection of three z-stacks at maximum projection giving a stack size of 2 microns in Z. Bar = 10 microns.

Structure

A microbody is an organelle bound by a single-boundary membrane. It's matrix, or intracellular material, is electron dense, and contains enzymes and other proteins. Constantly entering the organelle are phospholipids, which help to synthesize the membrane of expanding microbodies

and of new microbodies in the cell. Four different types of microbodies include: peroxisomes, glyoxysomes, glycosomes, hydrogenosomes (three of which are of the same origin).



Location

Microbodies are found in cells of plants, protozoa, and animals. There are many types of microbodies (see Function) found in eukaryotic cells. In vertebrates, microbodies are especially prevalent in the liver and kidney organs.

Function

The function of microbodies is specific to the cell type. However, across the board, all microbodies contain enzymes which participate in the preparatory or intermediate stages of biochemical reactions within the cell. Specifically, microbodies allow for the breakdown of fats, alcohols, and amino acids to take place. Microbodies in plants convert oils and/or fats to sugars that are used in energy-releasing reactions in the mitochondria. They also help breakdown about half of the ethyl alcohol which we consume. Often, hydrogen peroxide is a byproduct of these deconstructive reactions. Hydrogen peroxide itself is then broken down into water and oxygen.

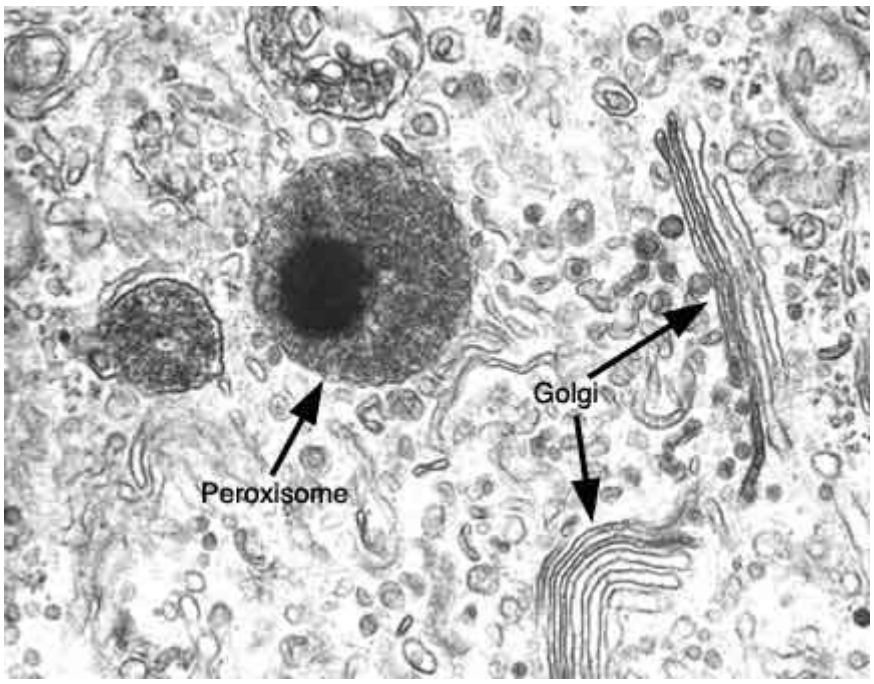
Properties of the Four Major Microbodies are as follows:

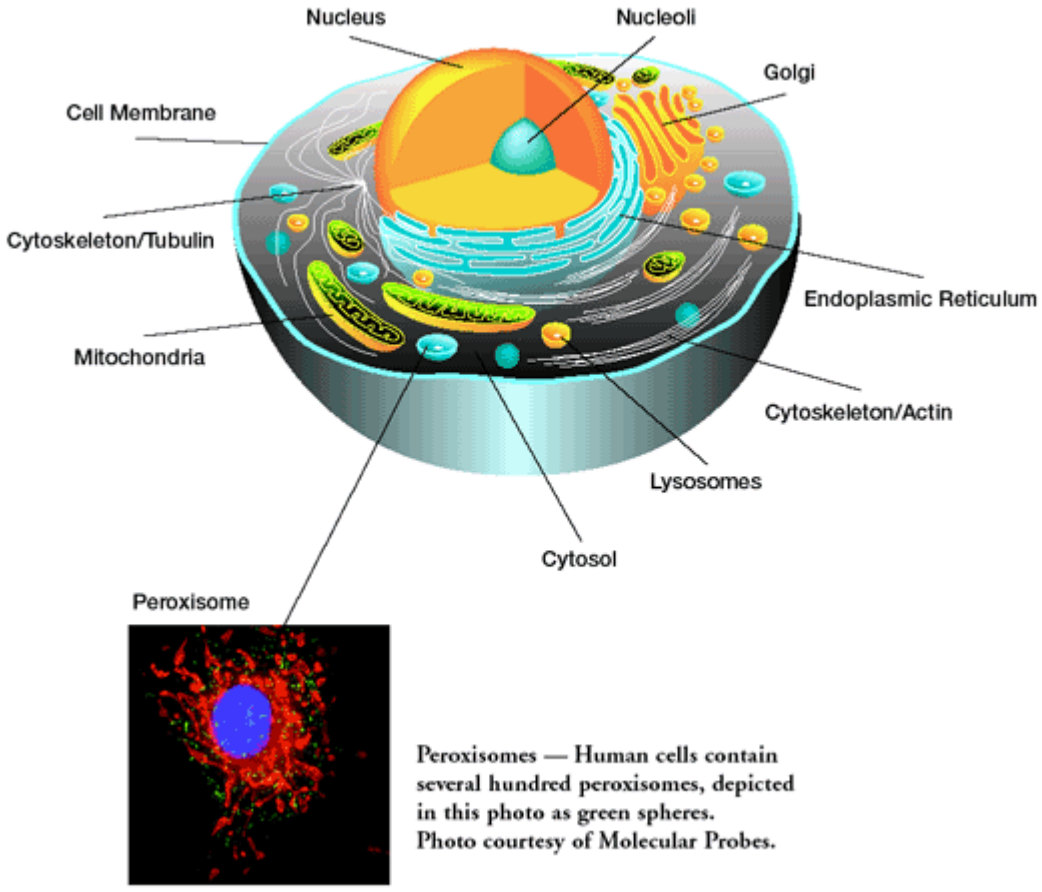
1) Peroxisome
A peroxisome is one of the two principal types of microbody. It is found in vertebrates, and takes part in the metabolism of fatty acids.It contains enzymes which expel toxic peroxides from the cell through oxidation reactions (eg. beta oxidation of long fatty-acid chains). During a reaction, these oxidative enzymes (like catalase) use oxygen to take away hydrogen from certain substrates to finally produce hydrogen peroxide. Proteins must be transported into the peroxisome because peroxisomes do not contain DNA.

2) Glyoxysome
Glyoxysomes are the other principal tpe of microbody. In terms of function, a glyoxysome is a more specialized type of peroxisome, containing enzymes used in the glyoxylate cycle to convert lipids into sugars. Glyoxysomes are the found in microorganisms and in plants (which germinate seeds).

3) Glycosome
Like Glyoxysomes, Glycosomes are also thought to stem from peroxisomes. They are microbodies which contain enzymes used for glycolysis, and they are found in protozoa (eg. pathogenic trypanosomes).

4) Hydrogenosome
Though double membraned, this organelle is still classified as a `microbody. (It may have evolved from the mitoc`

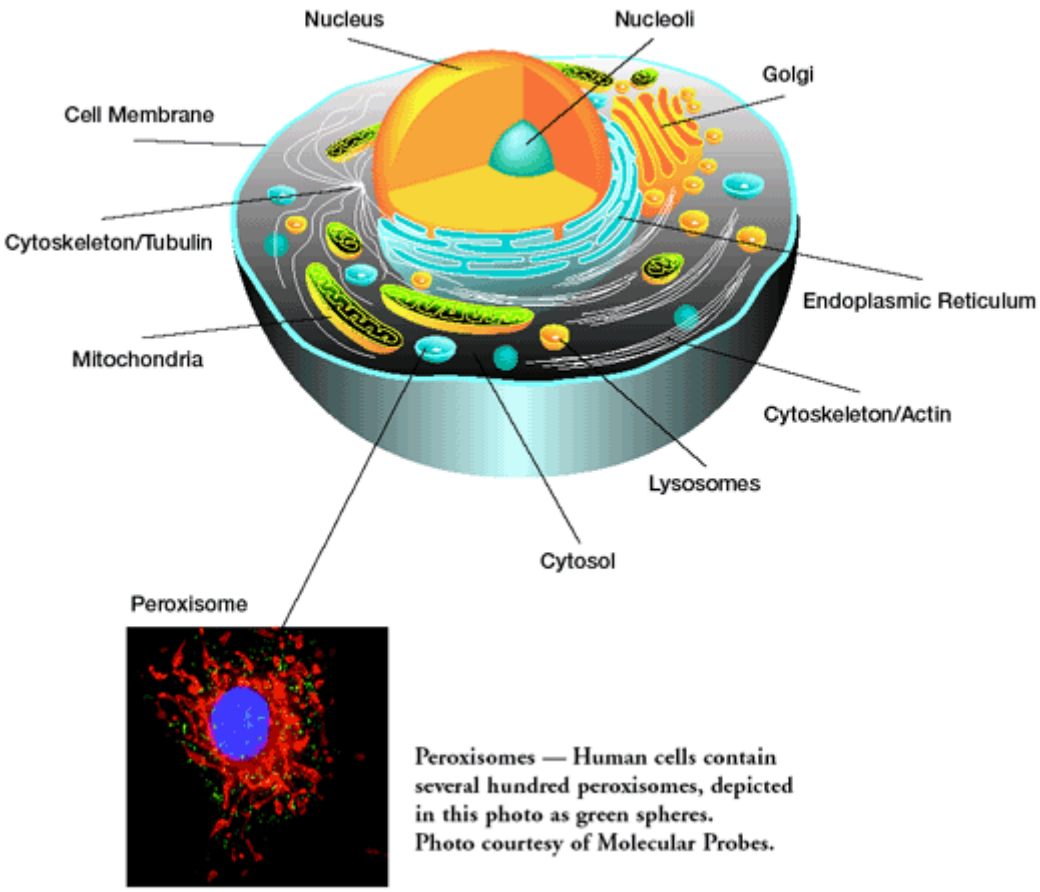




Peroxisomes — Human cells contain several hundred peroxisomes, depicted in this photo as green spheres. Photo courtesy of Molecular Probes.

Peroxisomes

Structure: *A single membrane, cytoplasmic organelle that is spherical in shape and contain digestive enzymes*
Function: *Uses digestive enzymes to break down toxic material in the cell.*



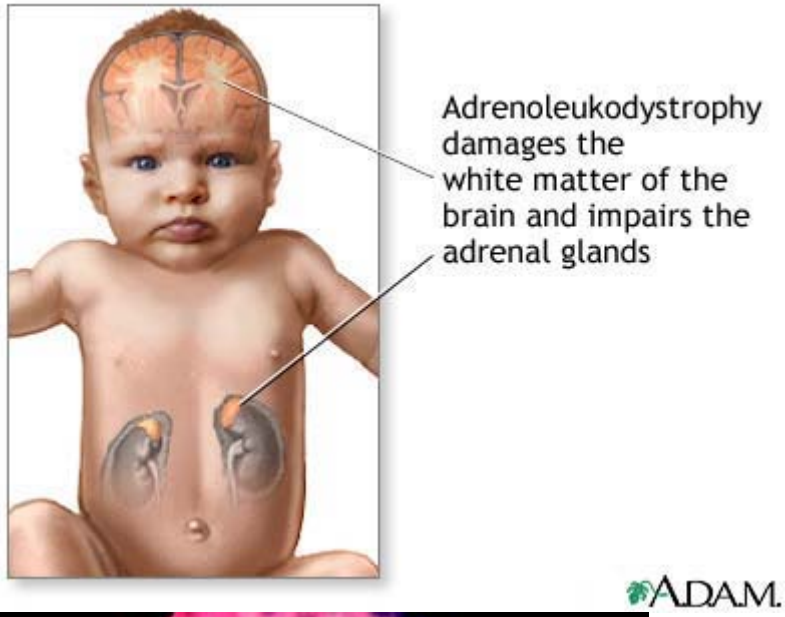
Peroxisomes — Human cells contain several hundred peroxisomes, depicted in this photo as green spheres. Photo courtesy of Molecular Probes.

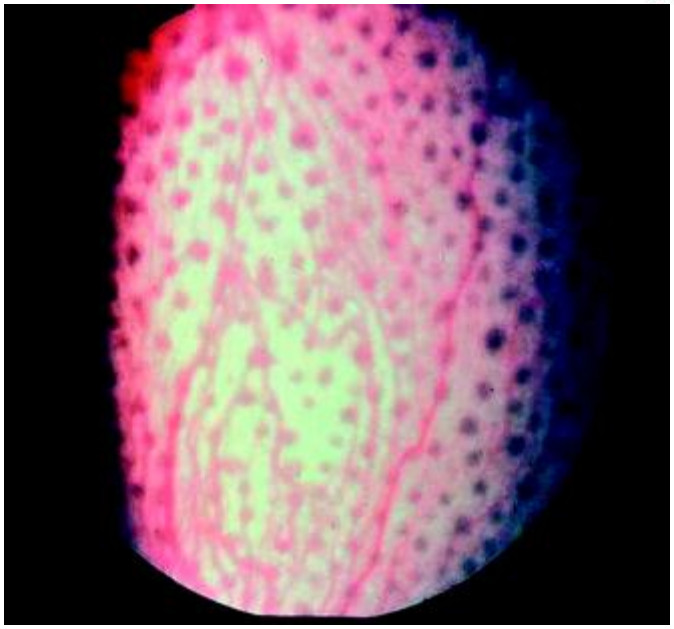
Peroxisomes are cytoplasmic organelles that contain oxidative enzymes that break down toxic chemicals in the cell. It got its name from using the enzymes to transfer hydrogen from various substrates to oxygen and produces hydrogen peroxide as a byproduct. These organelles may have many different functions. Some of them use oxygen to break down the fatty acids into smaller molecules which then can be transported to mitochondria as fuel for cellular respiration. Peroxisomes can also oxidize alcohol which is an important reaction in liver and kidney cells. The hydrogen peroxide formed by peroxisome is toxic but the organelle contains an enyzme that converts the hydrogen peroxisde to water. They also play a role in bile acid synthesis, cholesterol synthesis, plasmalogen synthesis, amino acid metabolism, and purine metabolism. There are specialized peroxisomes called glyoxysomes that are found in the fat-storing tissues of plant seeds. They contain enyzmes that initiate the conversion of fatty acids to sugar.
Unlike lysosomes, peroxisomes do not come off of the endomembrane system. They grow by taking in protein and lipids made in the cytosol and when they reach a certain size, they'll split into two.

Cellular Division

Peroxisomal Disorders

Peroxisomal disorders result from a reduced number or complete absence of peroxisomes and would affect the functions of many enzymes. Some disorders include Zellweger syndrome, neonatal adrenoleukodystrophy, hyperpipecolic acidemia, and infantile Refsum disease. Also, some people may have decreased muscle tone, cerebral malformations, seizures, and eye abnormalities. No specific treatment exists for peroxisomal disorders at this moment and unfortunately, nearly all of the disorders are lethal.

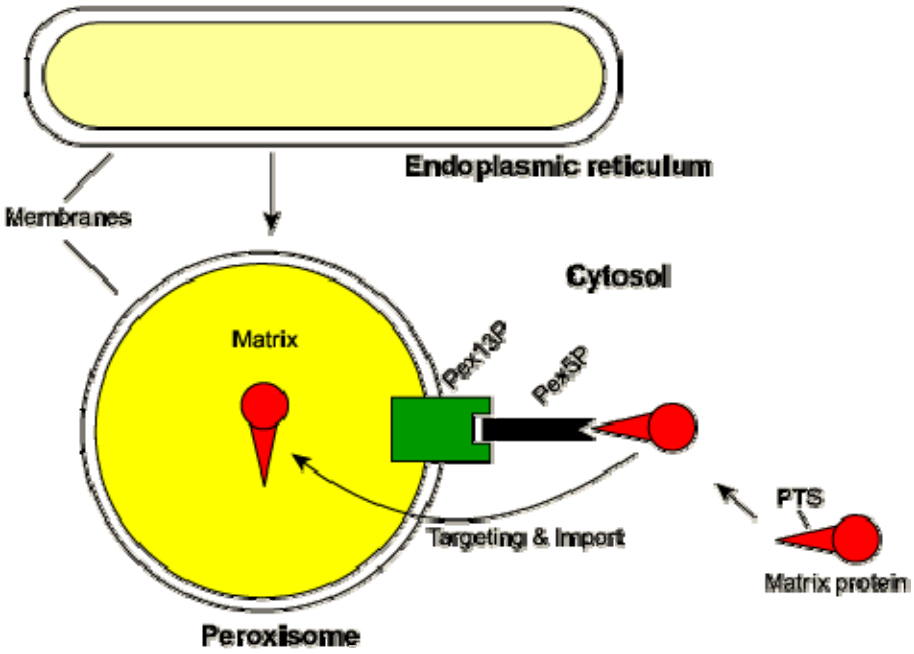




Neonatal adrenoleukodystrophy

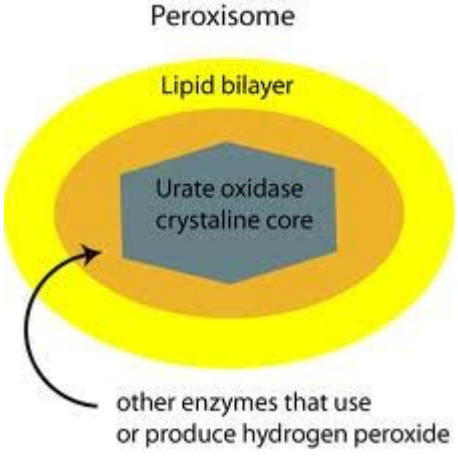
Peroxisomes are ubiquitous cellular compartments (organelles) involved in the metabolism of hydrogen peroxide and the beta-oxidation of fatty acids. To carry out these functions, peroxisomes contain a set of enzymes amongst which are oxidases that generate the harmful H2O2, and catalase that decomposes H2O2. Other peroxisomal enzymes are involved in the synthesis of cholesterol and unsaturated fatty acid. A number of inherited diseases cause impairement of peroxisome functions, such as the cerebro-hepato-renal Zellweger syndrome. This is a peroxisomal biogenesis disorder resulting in cells that are devoid of peroxisomes.
In most cell types, peroxisomes are particles of about 100-500 nm with a single membrane that surrounds an

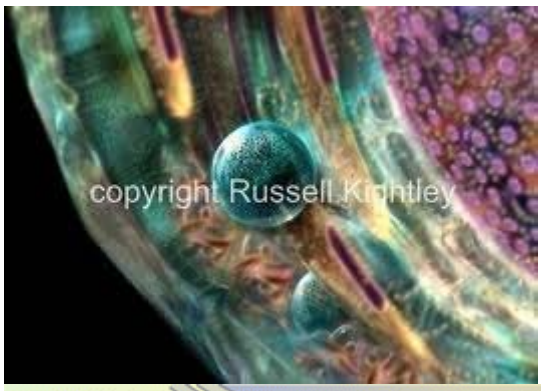
electron dense matrix when viewed in the electron microscope. It is not known where this membrane comes from. All peroxisomal proteins are synthesized at free ribosomes and are post-translationally transferred to the cytosol and imported into the peroxisomes. To this end, the newly synthesized proteins contain so-called peroxisomal targeting signals (PTSs) that are recognized by cytosolic receptor proteins for binding and guidance of the cargo to the peroxisomal membrane, a process that requires a number of additional proteins. Almost all matrix proteins have a type 1 PTS at their carboxyl terminus, specifically recognized by a receptor called Pex5p. Pex5p then binds to Pex13p, which is an integral membrane protein of the peroxisome. Through a series of poorly understood steps, Pex5p passes its cargo protein across the membrane into the matrix of the peroxisome (see scheme below). Recently, also in integral membrane proteins signal sequences have been characterized (mPTS) and Pex3p and Pex19p have been proposed to support the targeting of these proteins to the peroxisomal membrane Unlike other membrane sealed organelles, peroxisomes can import folded enzymes from the cytosol. This remarkable event does not require the assistance of intra- or extra-peroxisomal chaperones.

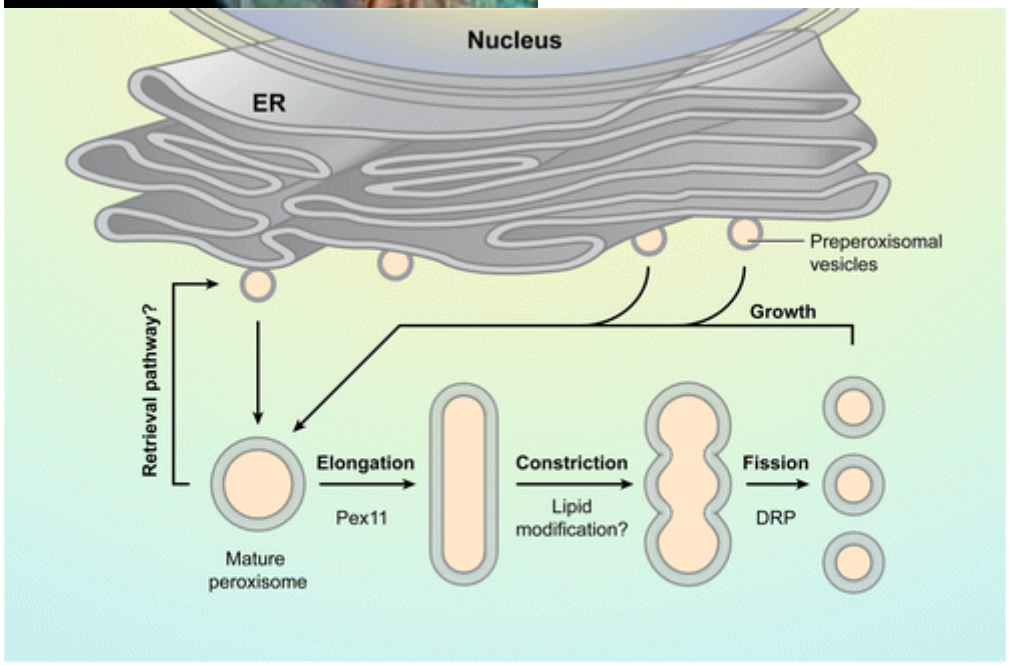


Simplified representation of the receptor-mediated protein import from the cytosol into the peroxisomal matrix.

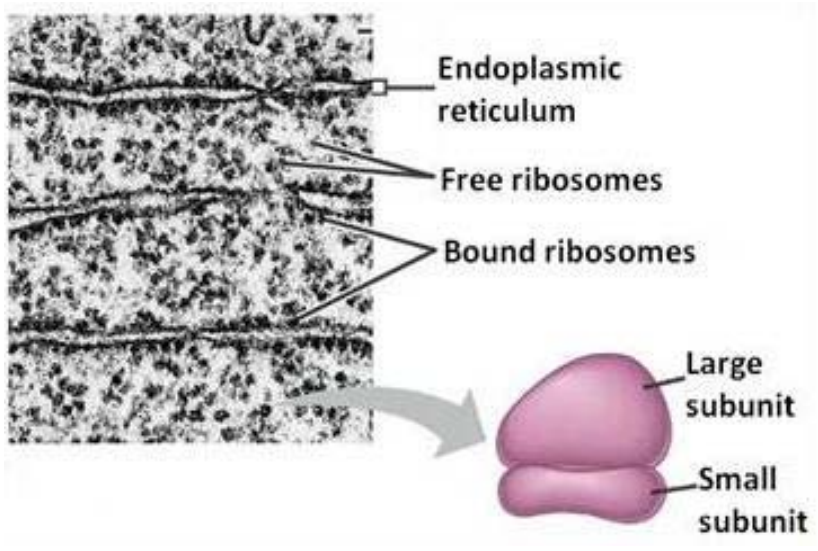
The peroxisome is the only organelle of which the formation is still unresolved. Since the 80ties, it was common believe that peroxisomes are autonomous organelles that multiply by growth and division. Recently however, this view has been challenged by data that hint for the endoplasmic reticulum as donor organelle. As further detailed under **Hans J. Geuze/Projects**, high resolution immuno-electron microscopy on dendritic cells has provided strong support for this latter view.







Fagarasanu A, et al. 2007.
Annu. Rev. Cell Dev. Biol. 23:321–44



Ribosome

Ribosomes are the site of protein synthesis therefore also called protein factories. Ribosomes are made up of ribosomal **RNA and proteins**.They are most abundant structure in the cell. An oocyte may contain upto 10^{12} ribosomes.

Ribosomes may be found as free ribosomes or bound

with endoplasmic reticulum.sometime many ribosomes are engaged in translating a single mRNA. They form polyribosome. Polyribosomes enhance the efficiency of translation of protein.

Foydalanilgan adabiyotlar

Asosiy adabiyotlar:	1.СвенсонК., УэбстерП. Клетка. М.: Мир, 1980.303с. 2.Заварзин А.А., Харазова А.А. Основы общей цитологии. Л. изд. ЛГУ, 1982. 240с. 3.Ченцов Ю.С. Цитология. М.: изд. МГУ, 1984. 352с. 4.Атабекова А.И.,Устинова Е.И. Цитология растений,из-во колос, Москва 1987г.
Qo'shimcha adabiyotlar:	Зенгбуш П. Молекулярная и клеточная биология. М.: Мир,1982. 215с. 6.Бойқобилов Т.Б., Икромов Т.Х. Цитология. Тошкент, «Ўқитувчи», 1980. 195с. 7.Фрей-Вислинг А. Сравнительная органеллография цитоплазмы. М., Мир, 1986. 144с. 8.Соттибоев И., Қўчқоров Қ. Ўсимлик ҳужайраси. Тошкент, «Ўқитувчи», 1991. 121с. 9.Г.Л.Билич. Биология, Цитология, гистология, Анатомия человека. Санкт-Петербург. Издательство «Союз». 2001 г 444с. 10.Абдулов И.А.,Қодирова Н.З. "Цитология" фанидан ўқув-услубий мажмуа. Тошкент 2011й. 11.Babadjanova S.X. "Sitologiya" fanidan O'UM. Urganch 2015 y.
Chet el adabiyotlar.	1. Botany an introduction plant's biology. Jeans D. Maneth.