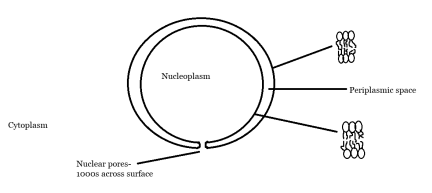
Cell Theory

Cells are the basic structural & functional unit of life.	Viruses do not qualify as living.
All living organisms are composed of cells.	No cellular structures,
All cells arise from pre-existing cells.	don't metabolize,
Spontaneous generation does NOT occur.	not motile,
	don't reproduce w/o a host cell

Nucleus



Double phospholipid bilayer membrane (nuclear envelope)
Biggest organelle in most cells
Ancestral prokaryote membrane folded in on itself, trapping DNA and protecting it

Nucleus cont.

The nuclear envelope is very restrictive	Contains most eukaryotic DNA (some DNA in chloroplasts and mitochondira)
Organizes DNA with chromosomal territories separated by proteins	Nucleolus is the site of ribosomal RNA (rRNA) synthesis and assembly
Protein structures and RNA can fit through nuclear pores to leave the nucleus	rRNA is the most abundant form of RNA, and is part of the ribosome

Golgi Apparatus

Functions to process, sort, and ship molecules synthesized in ER	"Post office" of the cell

Made up of **Cisternae** - all separate flattened membranes for vesicular transport

Cis side- ["same"] side facing ER	Trans side- ["opposite"] side facing away from ER

Vesicular transport can be tracked in a laboratory with a Green Fluorescent Protein (GFP)

Lysosomes

["breaking body"]

Acidified organelle specializing in digestion	pH=4.5-5
degrades material via endocytosis	(bring into cell, phagocytosis is a type of endocytosis)
enzymes work in the acidified environment to digest	they break down *intracellular* materials
Aid in *Autophagy*- ["self-eating"]	recycle things like mitochondria that are 'expired' to use material for other metabolic functions

Cell Diversity

Measured in micrometers	$1x10^3$µm = 1mm	$1x10^6$µm = 1m
bacteria= 1-10 µm	plant/animal= 10-100 µm	
round, rod, or spiral shape	shape is linked to function	*Form Fits Function*

Cell Diversity (cont)

Aerobic= needs oxygen	Anaerobic= without oxygen or oxygen is toxic
Prokaryote vs.	**Eukaryote**
>no membrane bound organelles	>membrane bound organelles
>Domains Bacteria & Archaea	>Domain Eukaryota

>Eukaryotes stress compartmentalization, using organelles with different functions and specialized roles.
>Protists are included in Eukaryota, being single celled Eukaryotes.

Ribosomes

Composed of rRNA and protein - rRNA does the actual translating	Performs protein synthesis (translation)
Possessed by ***ALL*** cells	Not membrane bound

2 different populations in eukaryotes:

Free (cytosolic)- floating around, makes cytoplasmic proteins	Bound to endoplasmic reticulum (ER)- makes ER proteins, cell membrane proteins
	Exists inside chloroplasts and mitochondria (to translate cpDNA and mtDNA)

cpDNA= chloroplast DNA
mtDNA= mitochondrial DNA

Smooth ER

site of synthesis of membrane lipids (phospholipids, cholesterol)	Ca^{2+} storage for muscle cell contraction
	> Ca^{2+} is a signalling molecule, kept in the smooth ER until needed for muscle contraction

Mitochondria

Site of cell respiration	(citric acid cycle, e^- transport)
has endosymbiotic origins:	
>double phospholipid bilayer membrane	>ancestral eukaryote with nuclear envelope and ER phagocytized an ancestral prokaryote that was good at cell respiration
Matrix- aqueous solution inside mitochondria	
Cristae- inner membrane of mitochondria	this increases surface area for cell respiration to occur
Key to initiation of **apoptosis**- programmed cell death	occurs when there is DNA damage, metabolic stress, or oxidative stress

Cytoskeleton

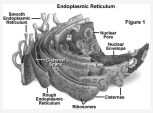
the cell's 'muscles and bones'

Filamentous proteins- 'bones', structure, support, shape	**Motor proteins**- 'muscles', contraction, cell movement
Functions:	
>contributes to *eukaryotic* cell shape	>controls all aspects of eukaryotic cell motility

Organelles

Cell Wall	**Cell Membrane**
possessed by most organisms: bacteria, protists, fungi, plants	possessed by *every* cell
provides structure and shape,	functions as: control entry and exit from cell (semi-permeable),
protection against hypotonic environment,	cell communication,
very porous to permit passage of nutrients.	adhesion to other cells (anchored with protein complexes).
	Phospholipid bilayer moves laterally and fluidly, composed of small pieces

Endoplasmic Reticulum



The ER is a physical extension directly connected to the outer membrane of the nuclear envelope.
> proteins in the nuclear membrane can diffused directly into the ER
Lumen= space in between membrane of ER

Rough ER

"Rough" because of ribosomes on the surface

site of synthesis for:

endomembrane system proteins	secreted proteins
Endomembrane system: ER, golgi, lysosome, cell membrane	Secreted proteins function outside cells (eg. antibodies)

Rough ER (cont)

>nucleus/rough/smooth ER -> vesicle -> golgi -> vesicle -> lysosome or cell membrane

Chloroplast

Site of photosynthesis (CO_2 to glucose etc. using light energy)	(plants, photosynthetic protists)
Thylakoid- flat stacks of membrane, possess photosynthetic enzymes	>site of *light reaction*
Stroma- aqueous solution within chloroplast	>site of *dark reaction/- Calvin cycle*
Double phospholipid bilayer membrane	
endosymbiotic origins: photosynthetic prokaryote became organelle in eukaryote	

Evidence of Endosymbiosis

Mitochondria and Chloroplasts possess:

>double phospholipid bilayer membrane

>mtDNA (mitochondrial DNA)	>cpDNA (chloroplast DNA)
>ribosomes	
>division that mimics that of bacteria (*binary fission*)	
>division is completed when 'half-life' of mitochondria/chloroplast is spent	