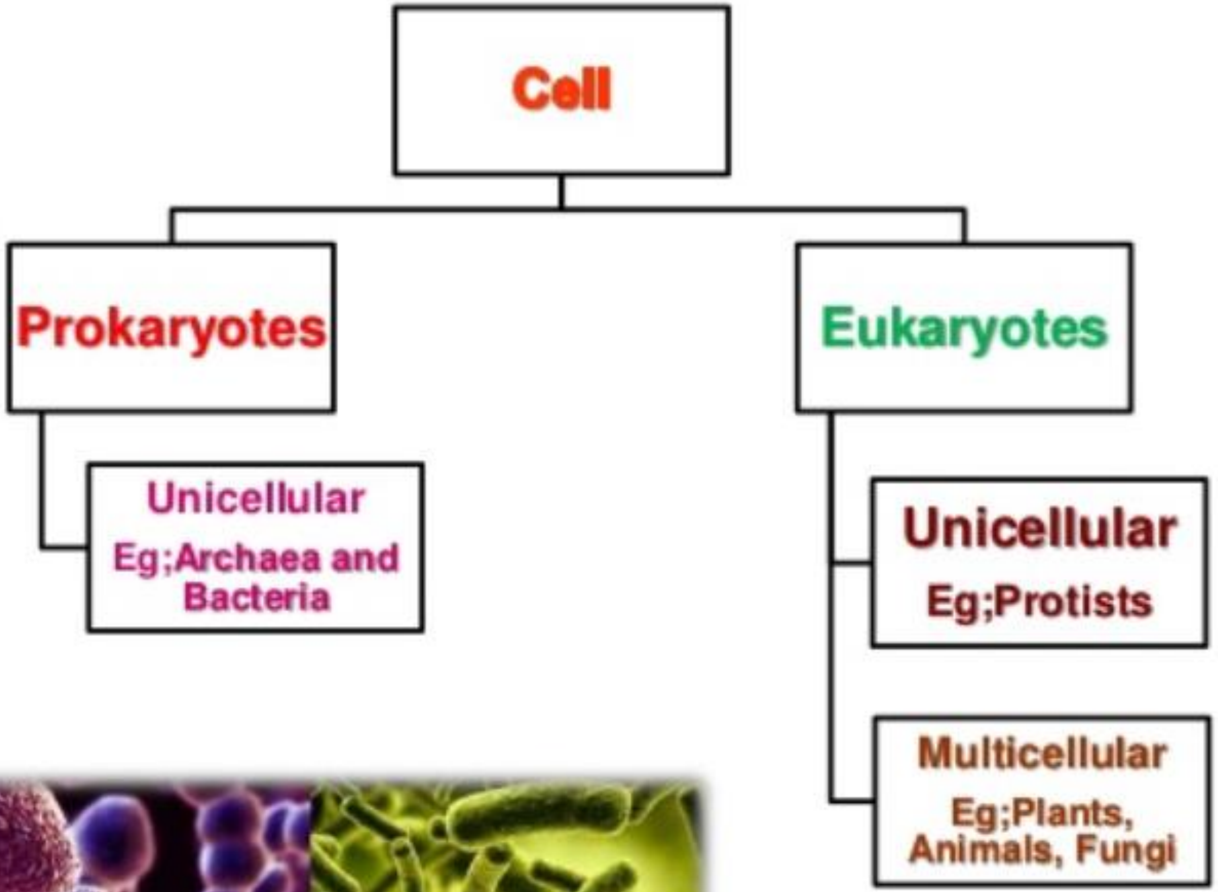
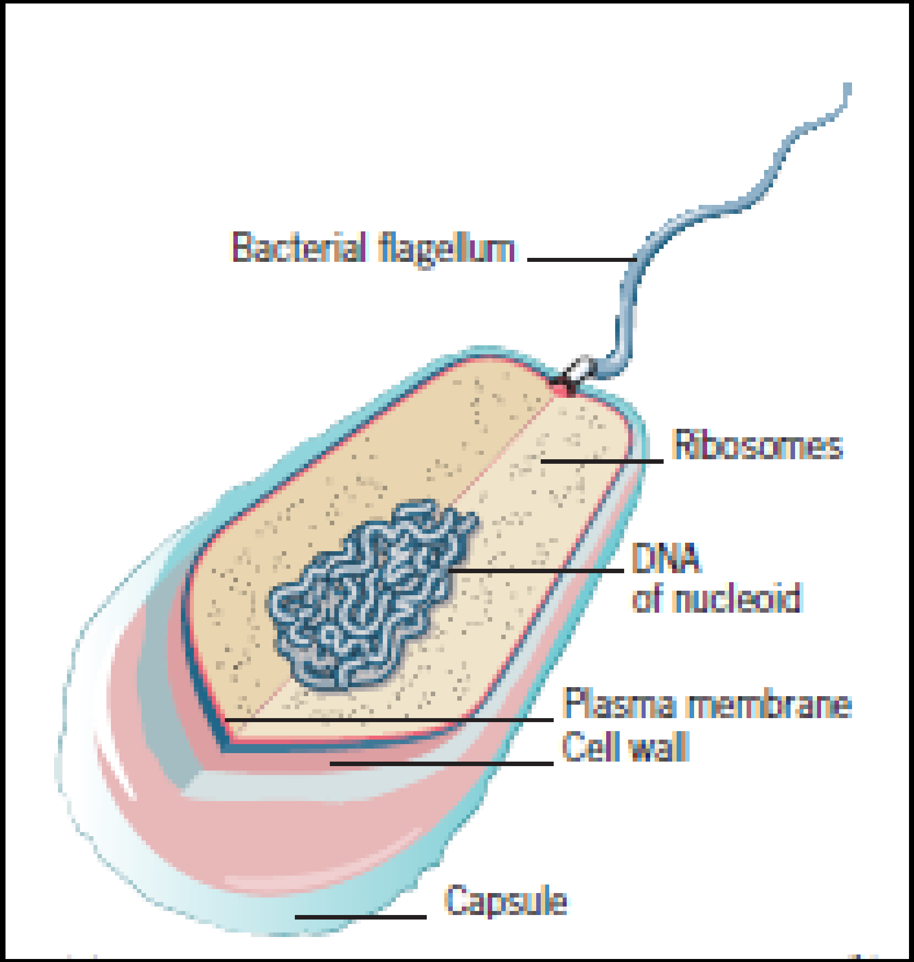
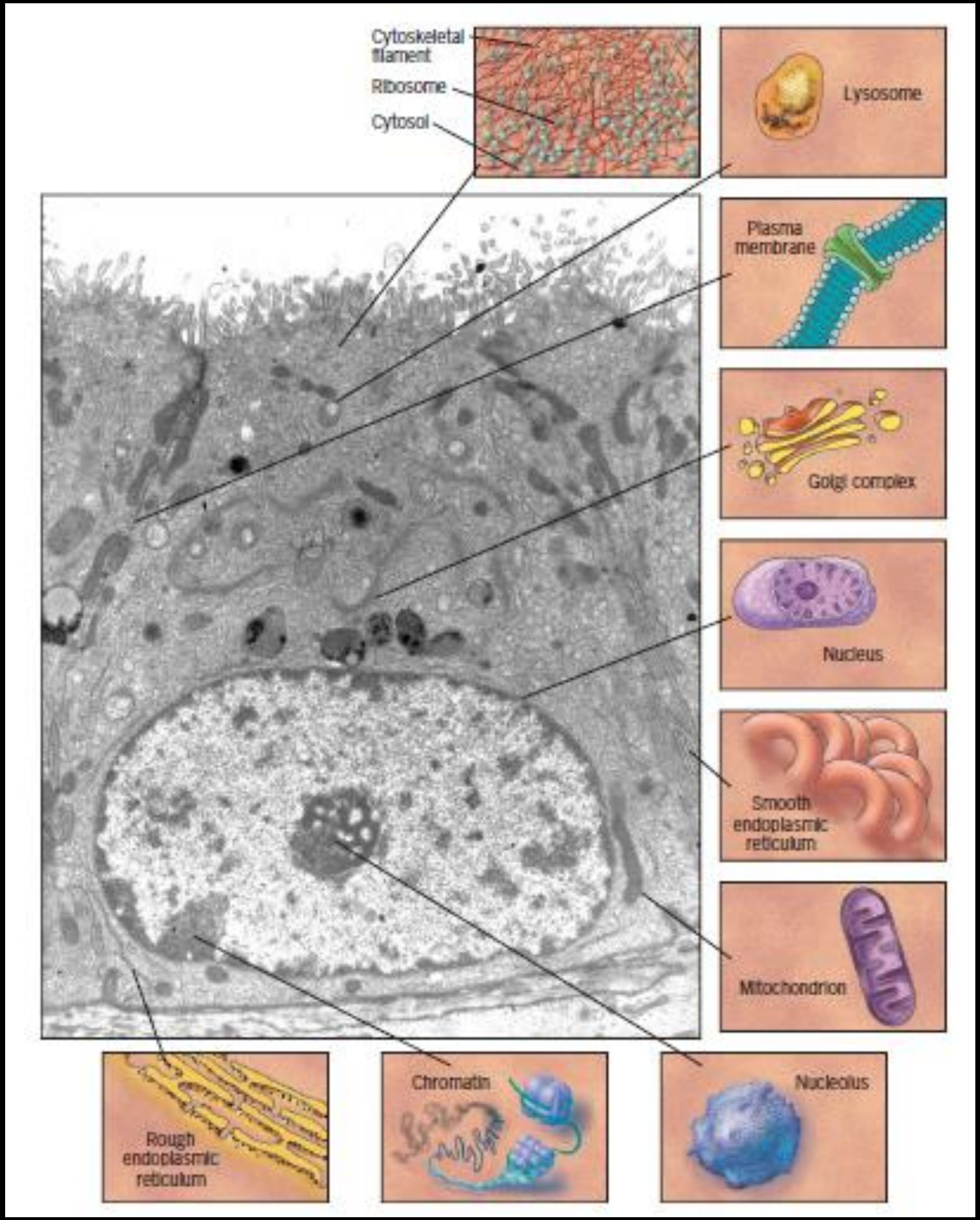
The Discovery of Cells


Robert Hooke - 1665
Slice of Cork
Cork Cells

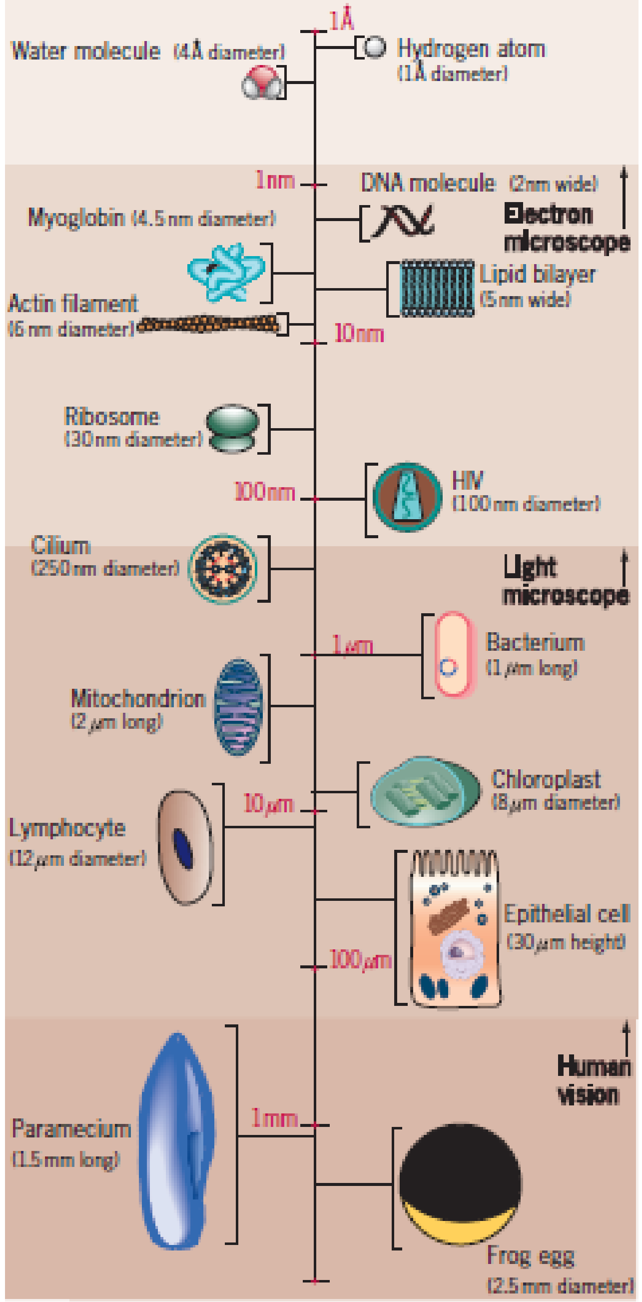

Cell
Prokaryotes
Unicellular
Eg;Archaea and Bacteria
Eukaryotes
Unicellular
Eg;Protists
Multicellular
Eg;Plants, Animals, Fungi

PROKARYOTIC CELL: Archaea or Eubacteria

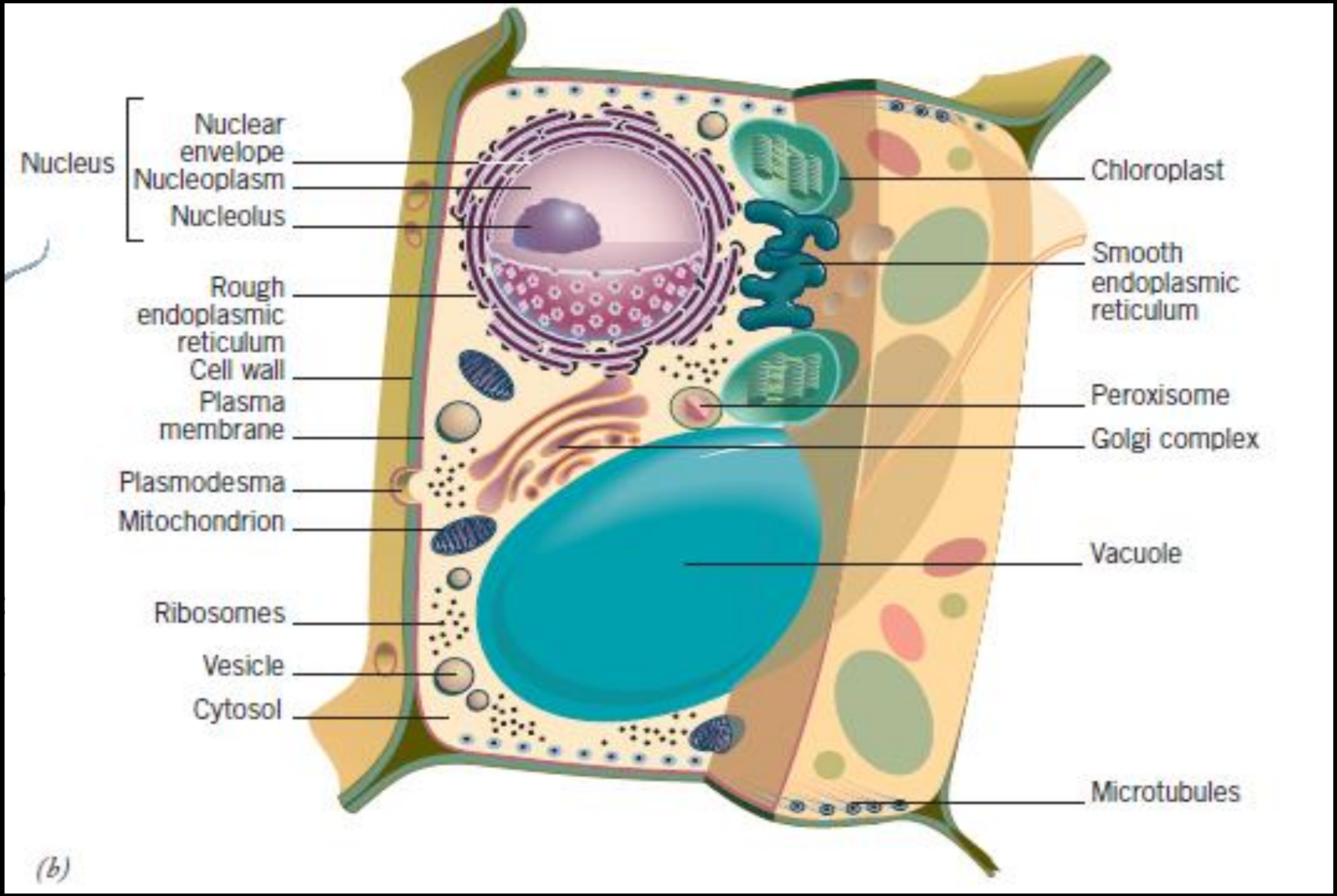




EUKARYOTIC CELL

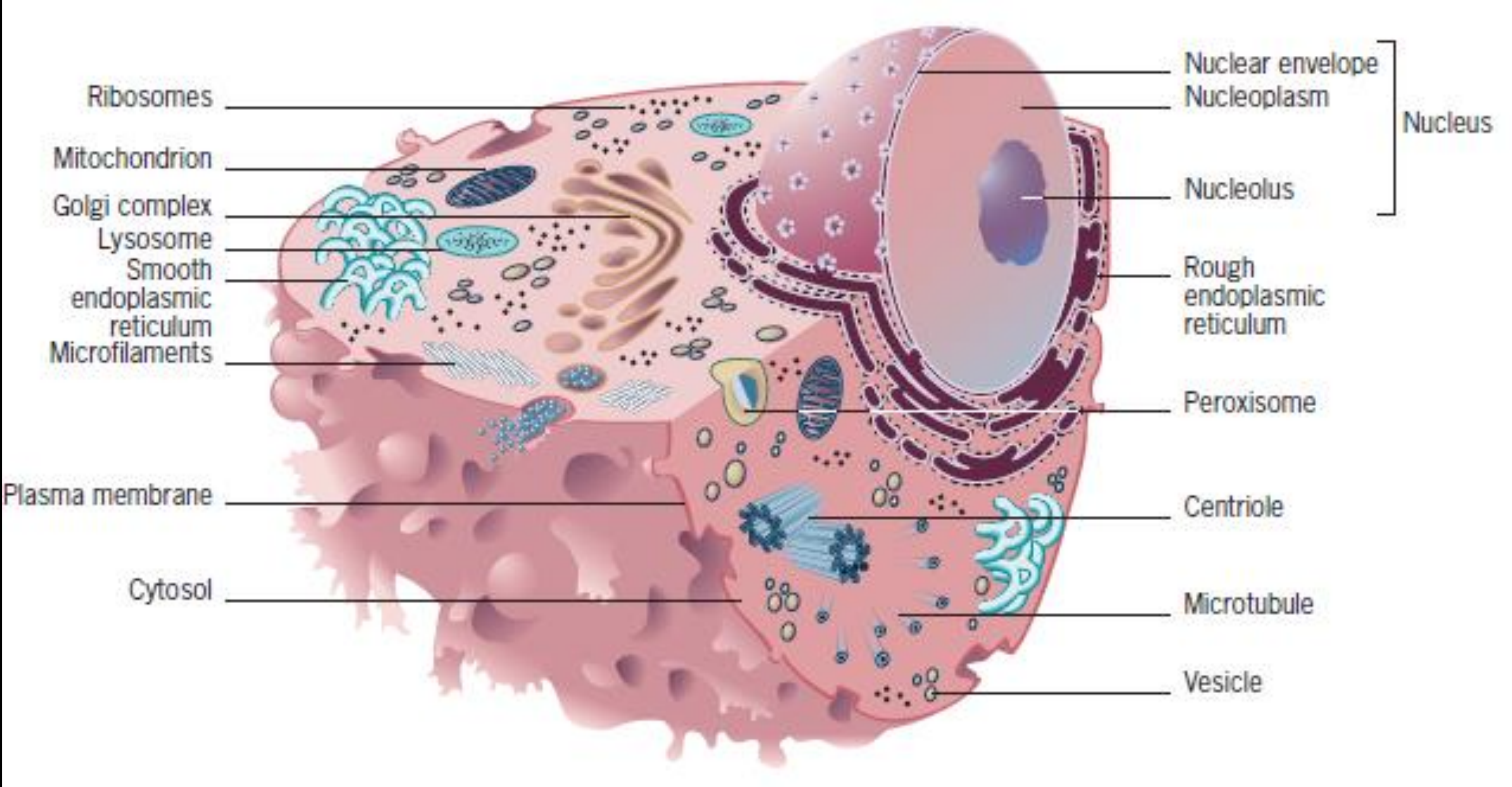

1Å
Water molecule (4Å diameter)
Hydrogen atom (1Å diameter)
1nm
DNA molecule (2nm wide)
Electron microscope
Myoglobin (4.5 nm diameter)
Lipid bilayer (5nm wide)
Actin filament (6 nm diameter)
10nm
Ribosome (30nm diameter)
HIV (100 nm diameter)
100nm
Cilium (250nm diameter)
Light microscope
1 μm
Bacterium (1 μm long)
Mitochondrion (2 μm long)
Chloroplast (8μm diameter)
10μm
Lymphocyte (12μm diameter)
Epithelial cell (30μm height)
100μm
Human vision
Paramecium (1.5 mm long)
1mm
Frog egg (2.5 mm diameter)

PLANT CELL

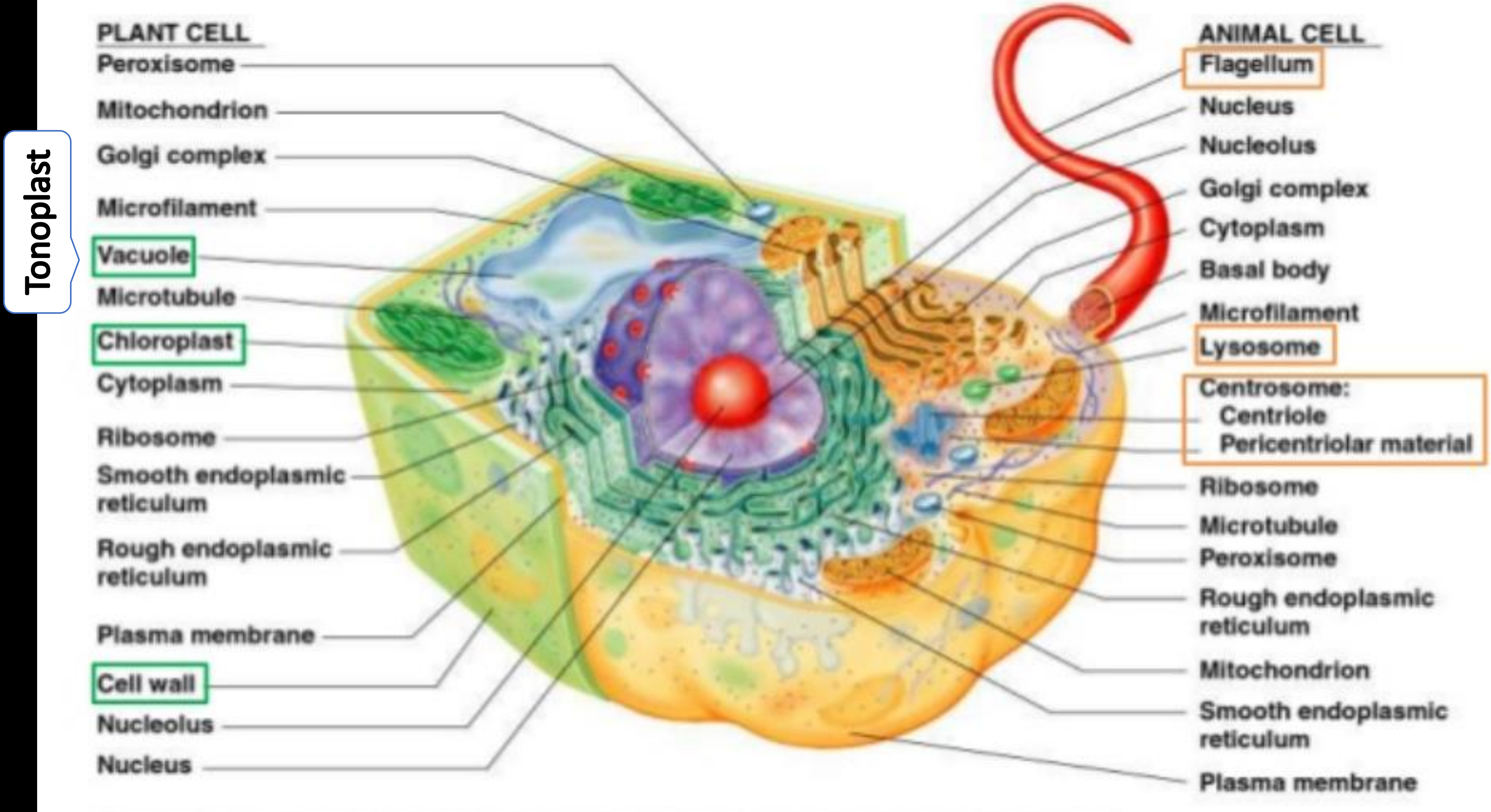


Nucleus
Nuclear envelope
Nucleoplasm
Nucleolus
Rough endoplasmic reticulum
Cell wall
Plasma membrane
Plasmodesma
Mitochondrion
Ribosomes
Vesicle
Cytosol
Chloroplast
Smooth endoplasmic reticulum
Peroxisome
Golgi complex
Vacuole
Microtubules
(b)

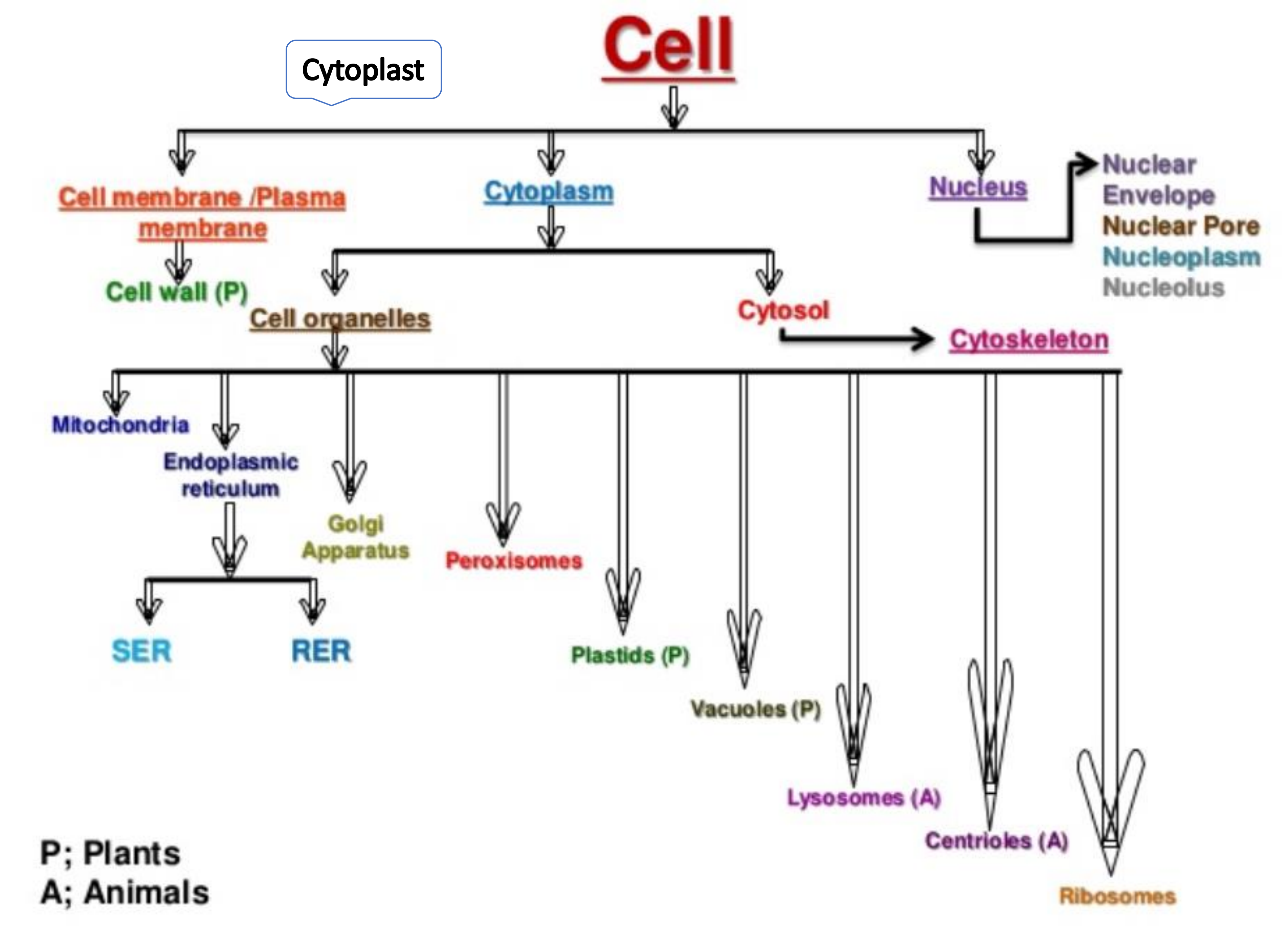
ANIMAL CELL


Ribosomes
Mitochondrion
Golgi complex
Lysosome
Smooth endoplasmic reticulum
Microfilaments
Plasma membrane
Cytosol
Nuclear envelope
Nucleoplasm
Nucleolus
Nucleus
Rough endoplasmic reticulum
Peroxisome
Centriole
Microtubule
Vesicle

Plant cell vs Animal cell

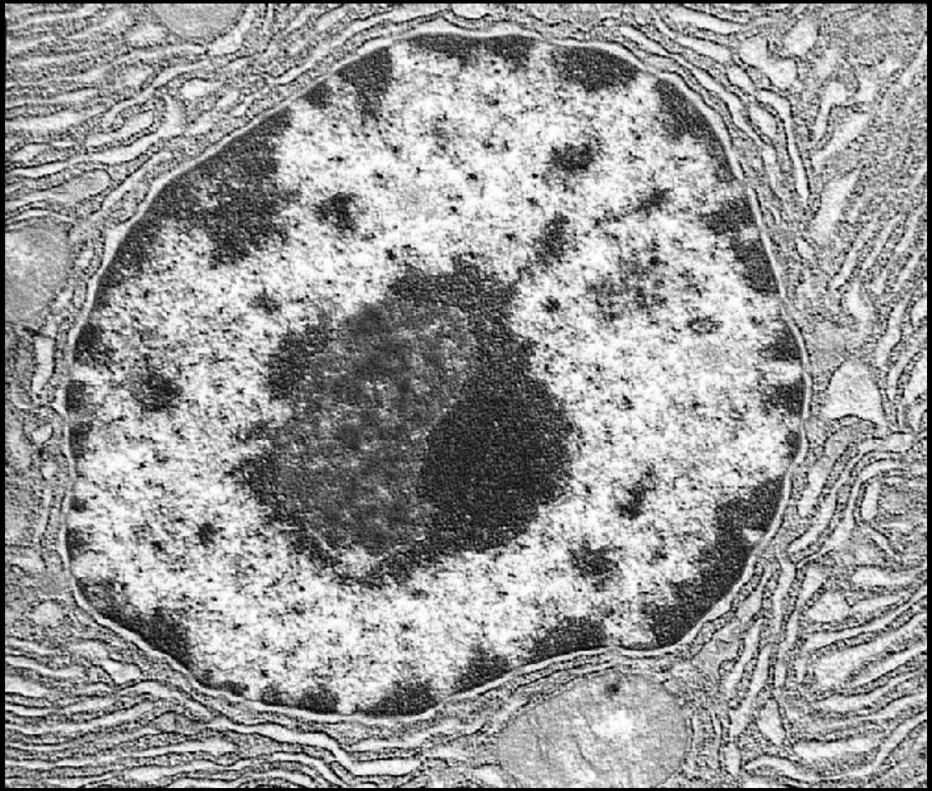


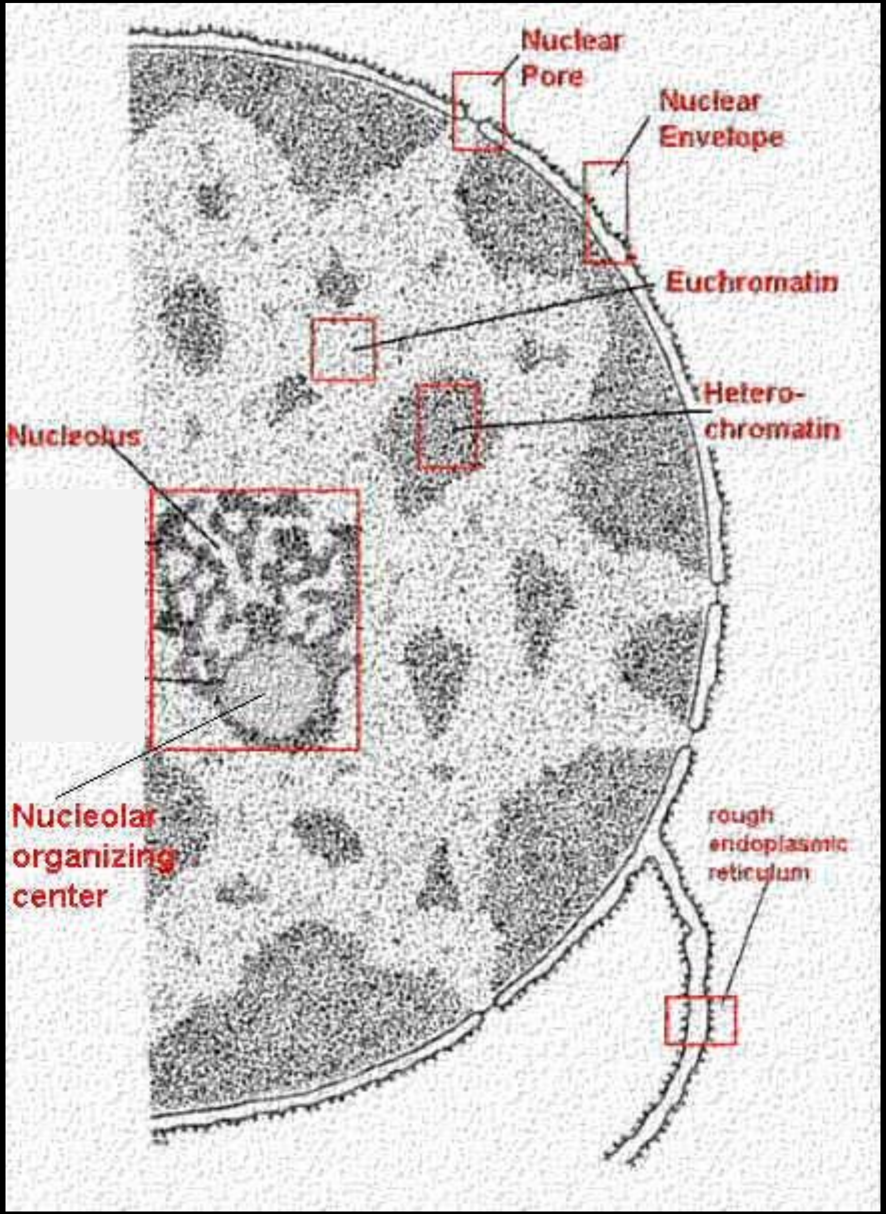
(a) Highly schematic diagram of a composite eukaryotic cell, half plant and half animal



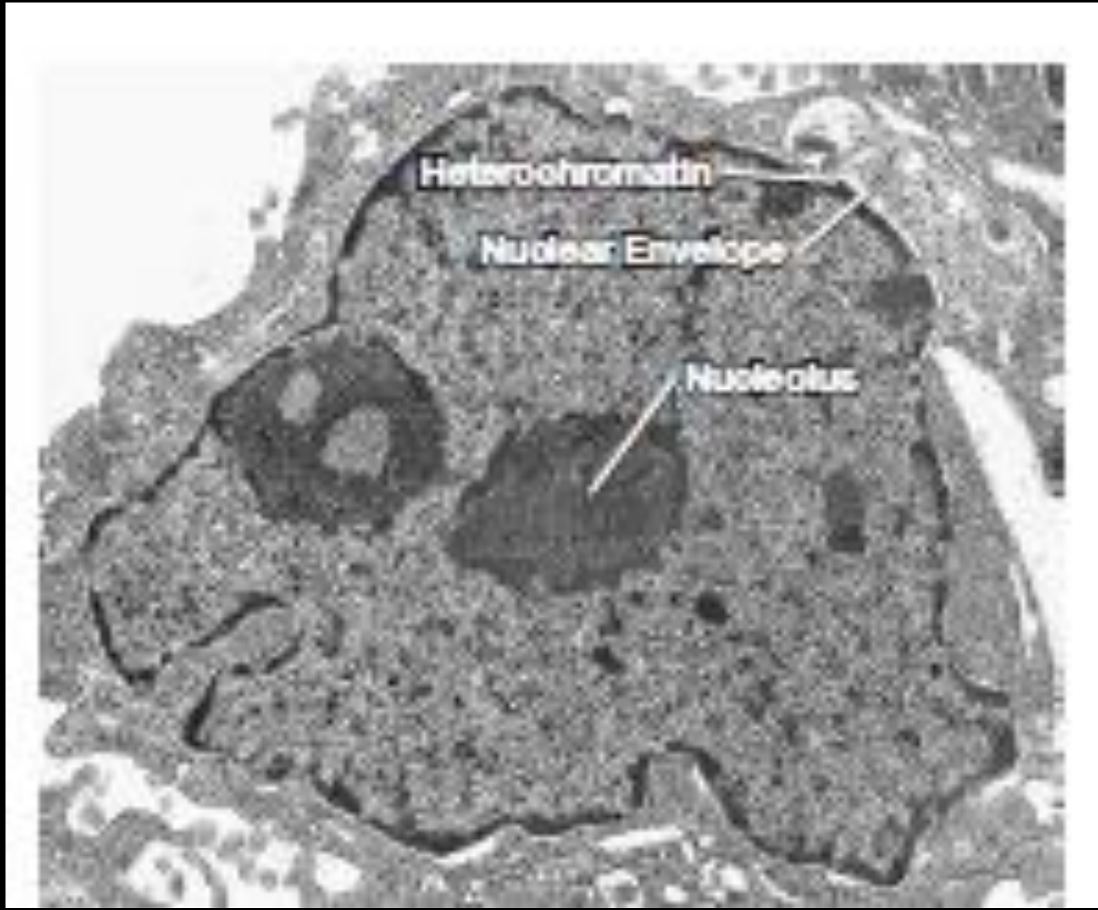
Cell
Cytoplast
Cell membrane /Plasma membrane
Cytoplasm
Nucleus
Nuclear Envelope
Nuclear Pore
Nucleoplasm
Nucleolus
Cell wall (P)
Cell organelles
Cytosol
Cytoskeleton
Mitochondria
Endoplasmic reticulum
Golgi Apparatus
Peroxisomes
SER
RER
Plastids (P)
Vacuoles (P)
Lysosomes (A)
Centrioles (A)
Ribosomes
P; Plants
A; Animals

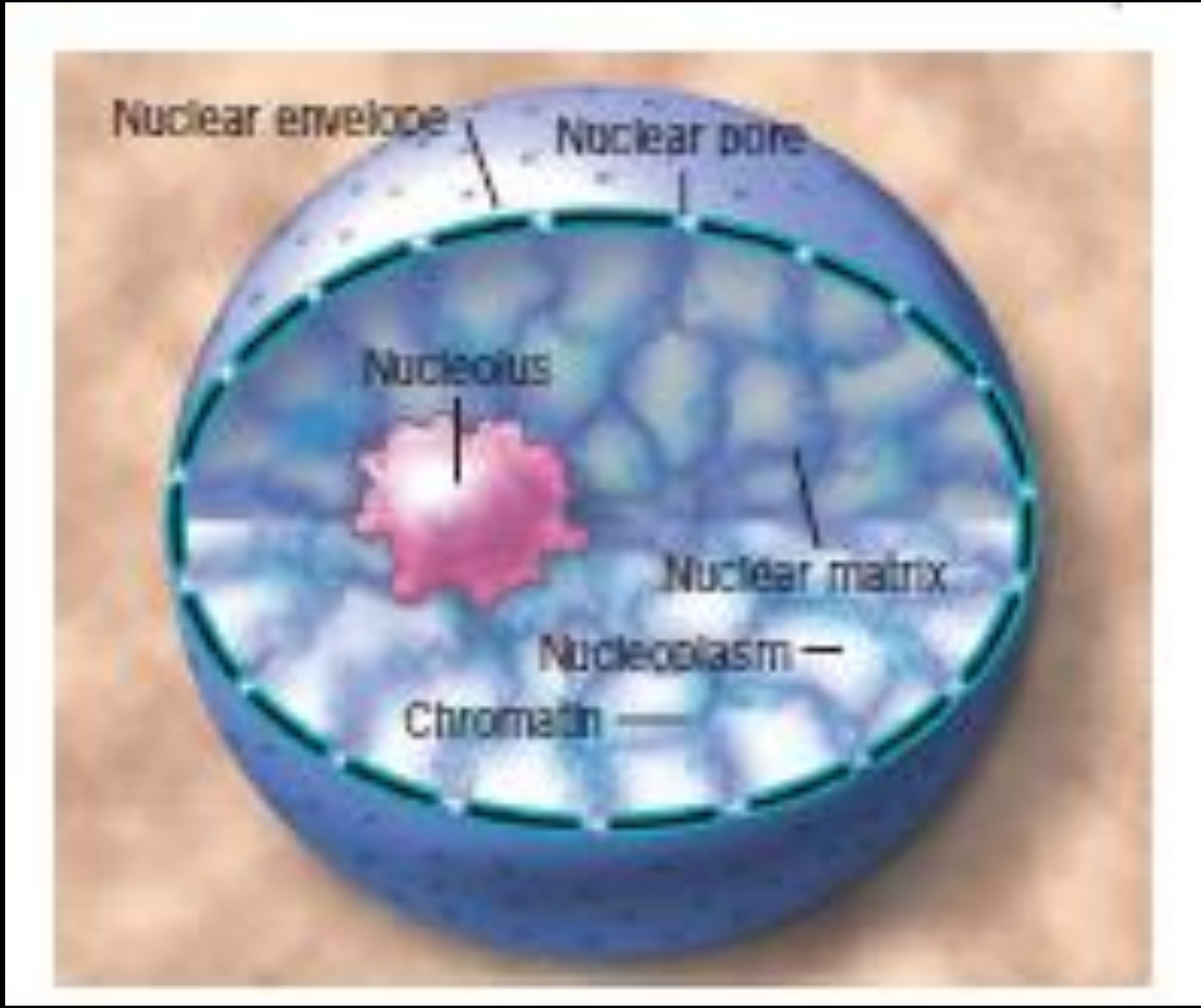
Unit 3(e): Nucleus





NUCLEUS


Heterochromatin
Nuclear Envelope
Nucleolus


Nuclear envelope
Nuclear pore
Nucleolus
Nuclear matrix
Nucleoplasm
Chromatin

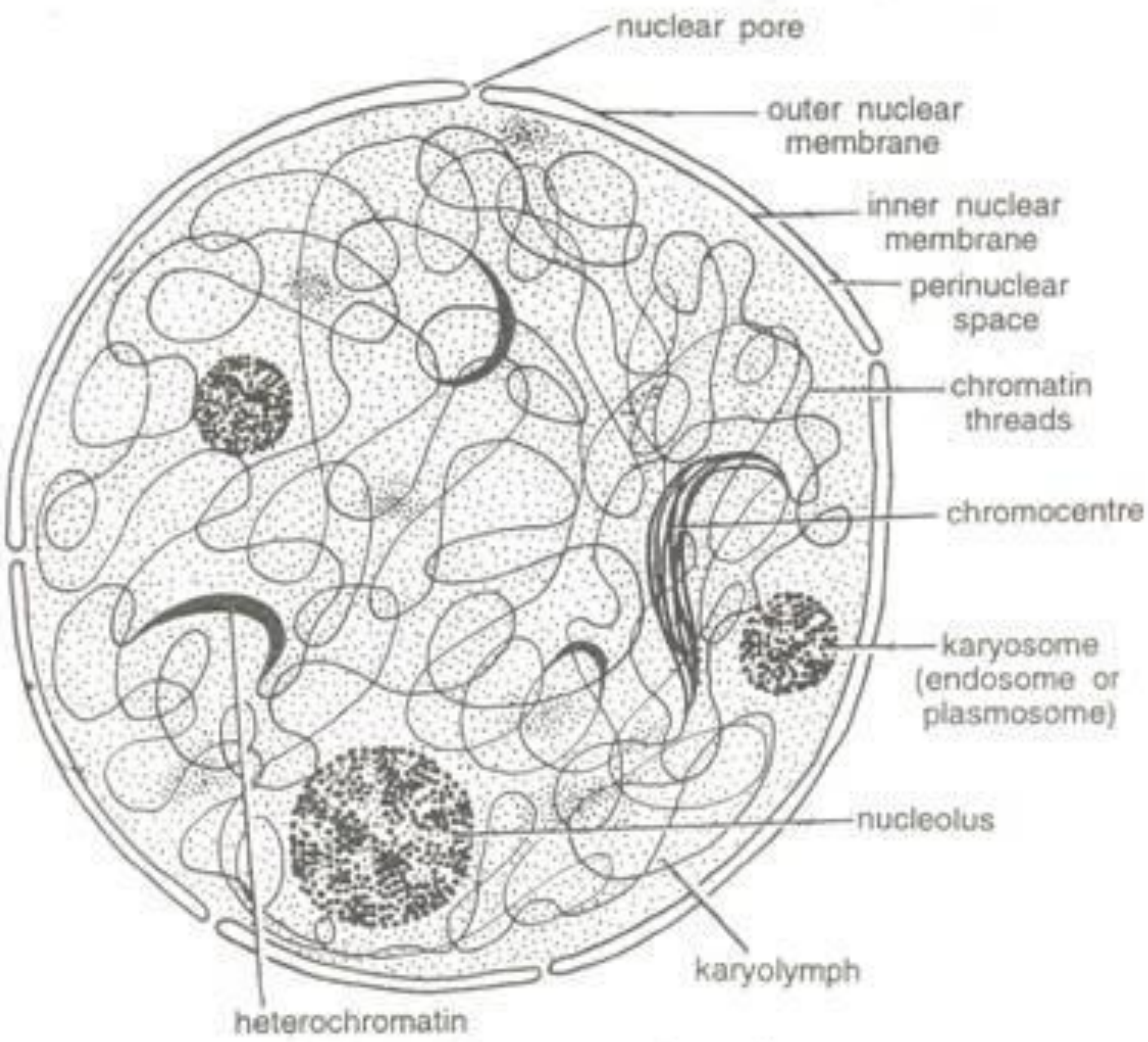
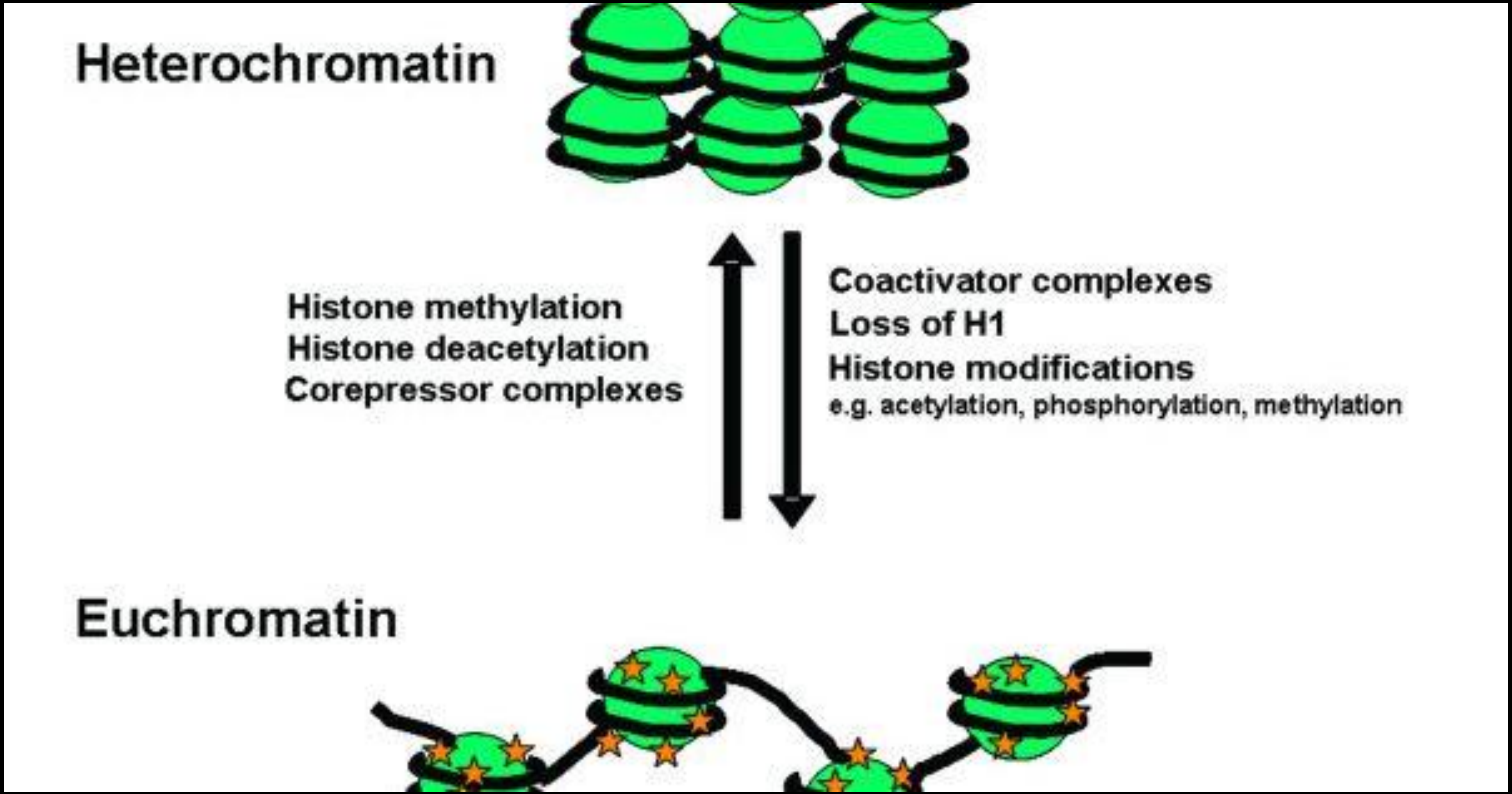
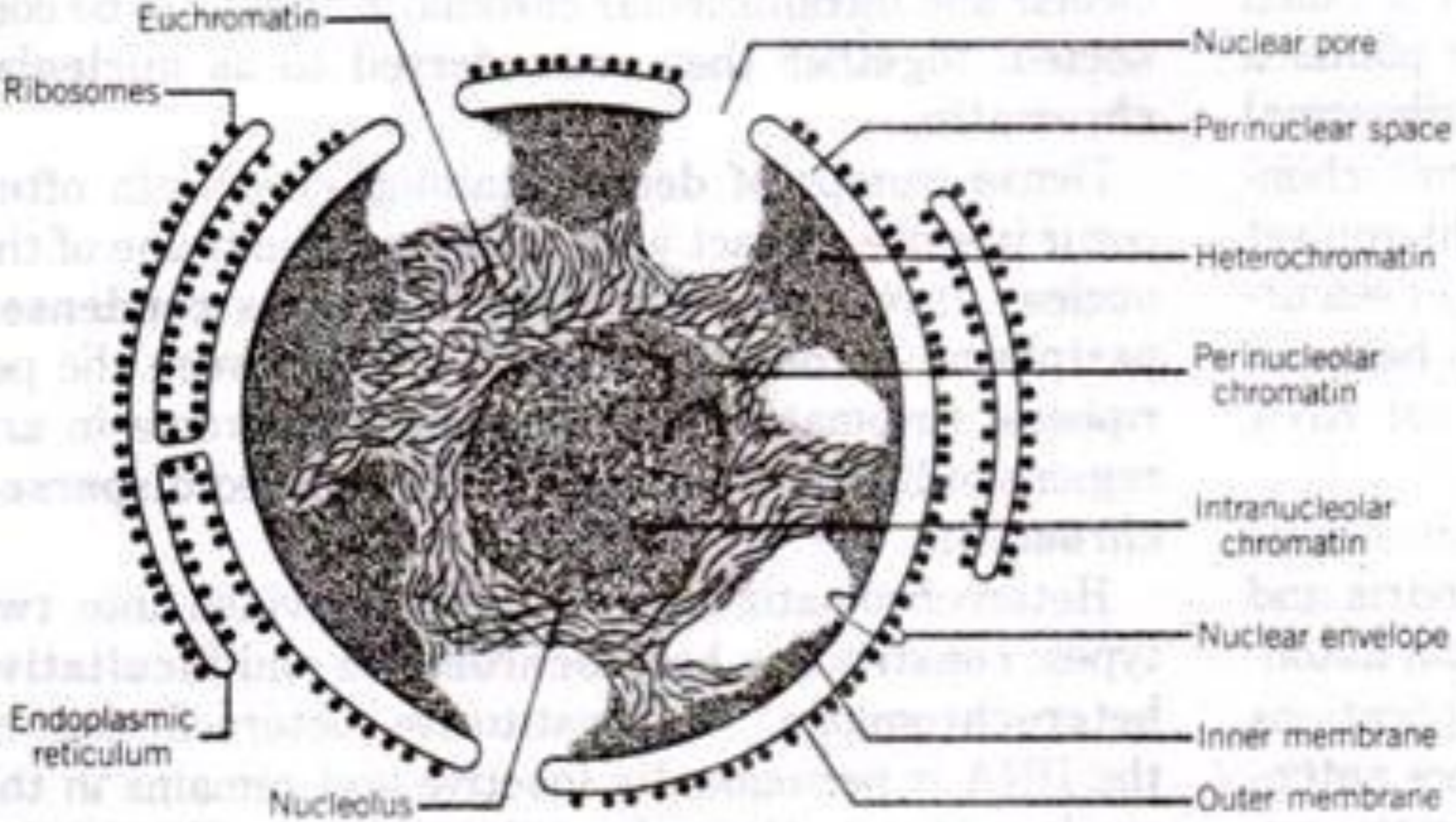
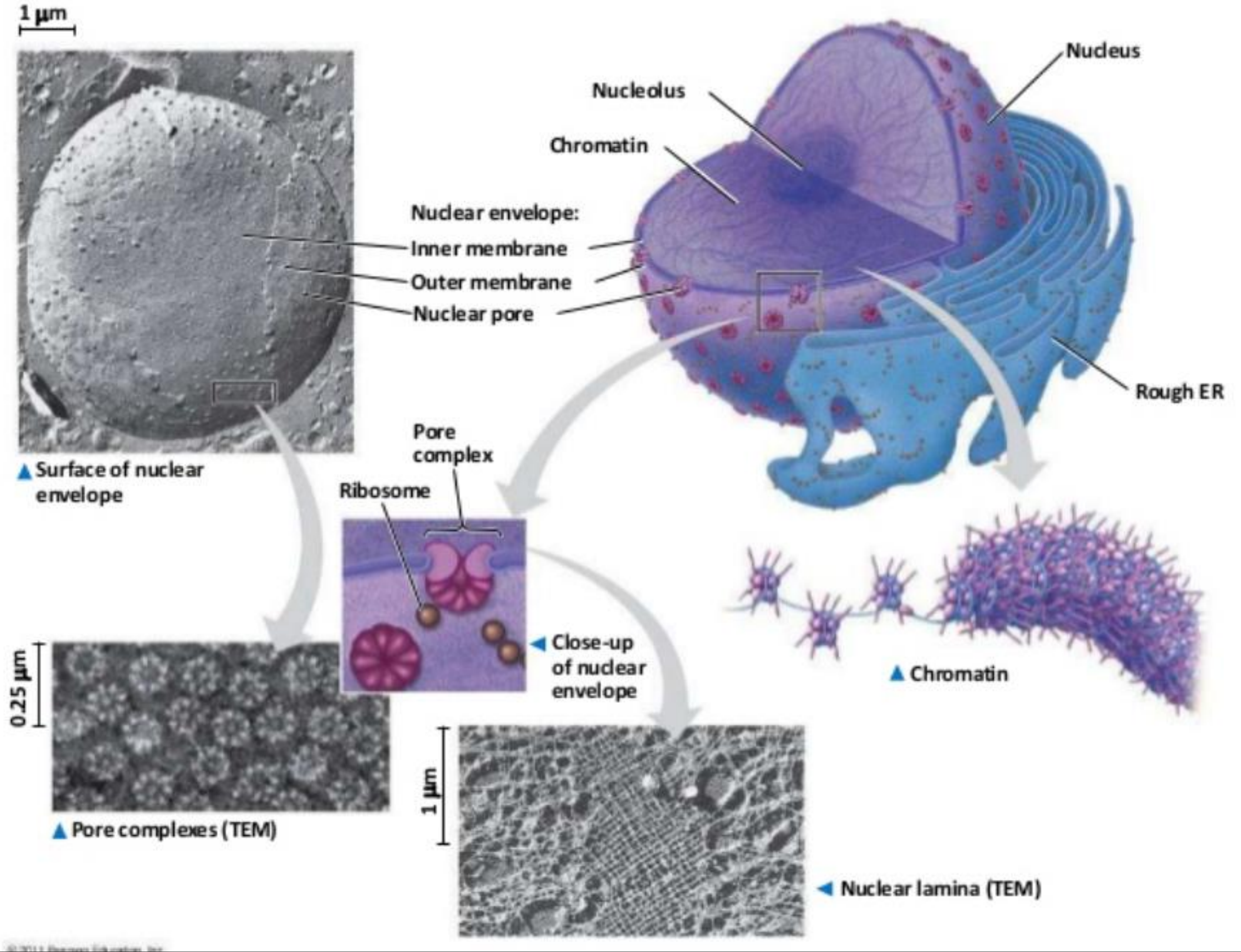


Fig. 2. Ultrastructure of a nucleus.


Heterochromatin
Histone methylation
Histone deacetylation
Corepressor complexes
Coactivator complexes
Loss of H1
Histone modifications
e.g. acetylation, phosphorylation, methylation
Euchromatin



Euchromatin
Ribosomes
Nuclear pore
Perinuclear space
Heterochromatin
Perinucleolar chromatin
Intranucleolar chromatin
Nuclear envelope
Inner membrane
Outer membrane
Endoplasmic reticulum
Nucleolus


1 µm
Nucleus
Nucleolus
Chromatin
Nuclear envelope:
Inner membrane
Outer membrane
Nuclear pore
Rough ER
Surface of nuclear envelope
Pore complex
Ribosome
Close-up of nuclear envelope
Chromatin
0.25 µm
Pore complexes (TEM)
1 µm
Nuclear lamina (TEM)

Nuclear Pore Complex

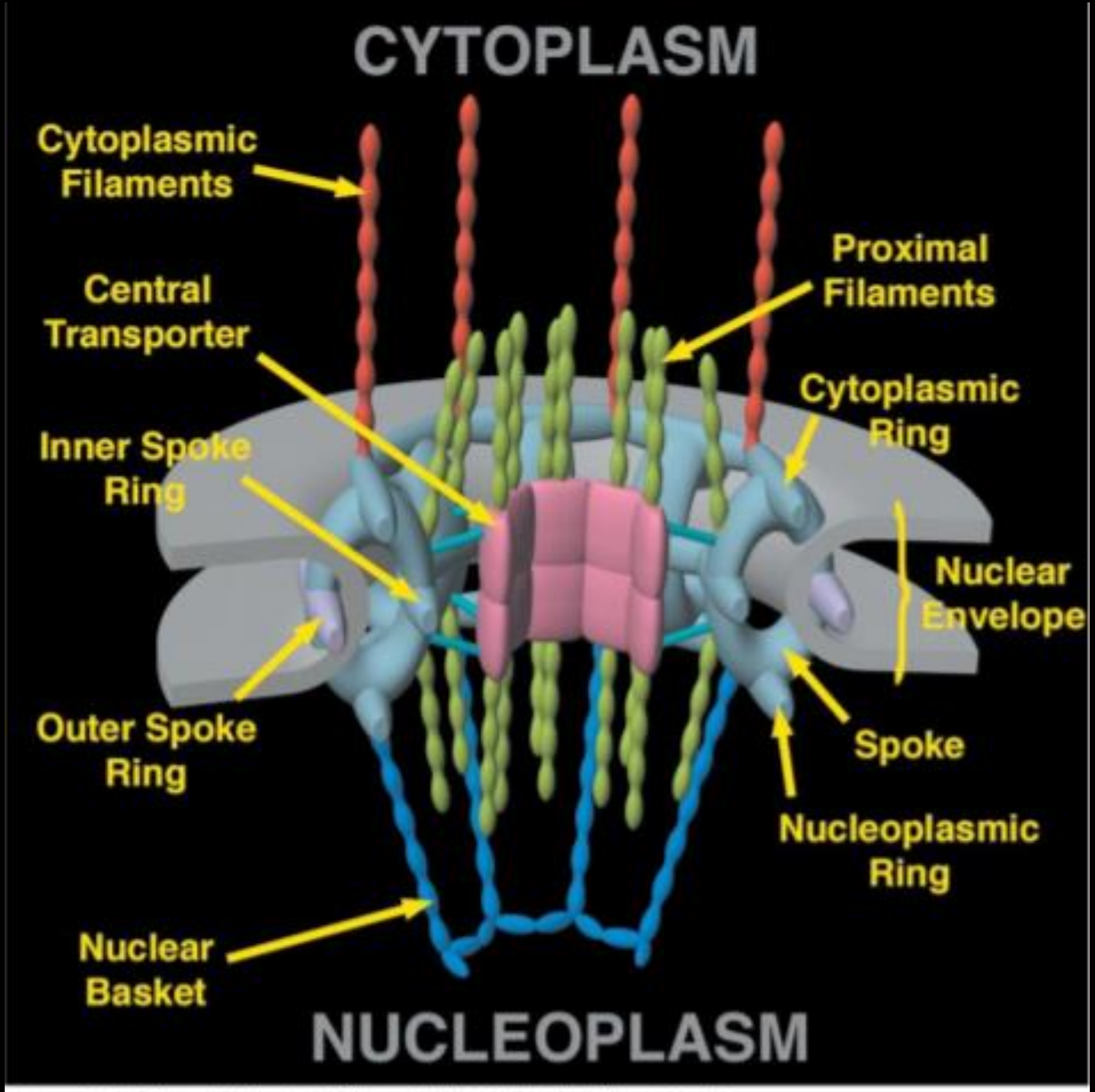


Figure 12-6 Cell and Molecular Biology, 4/e (© 2005 John Wiley & Sons)

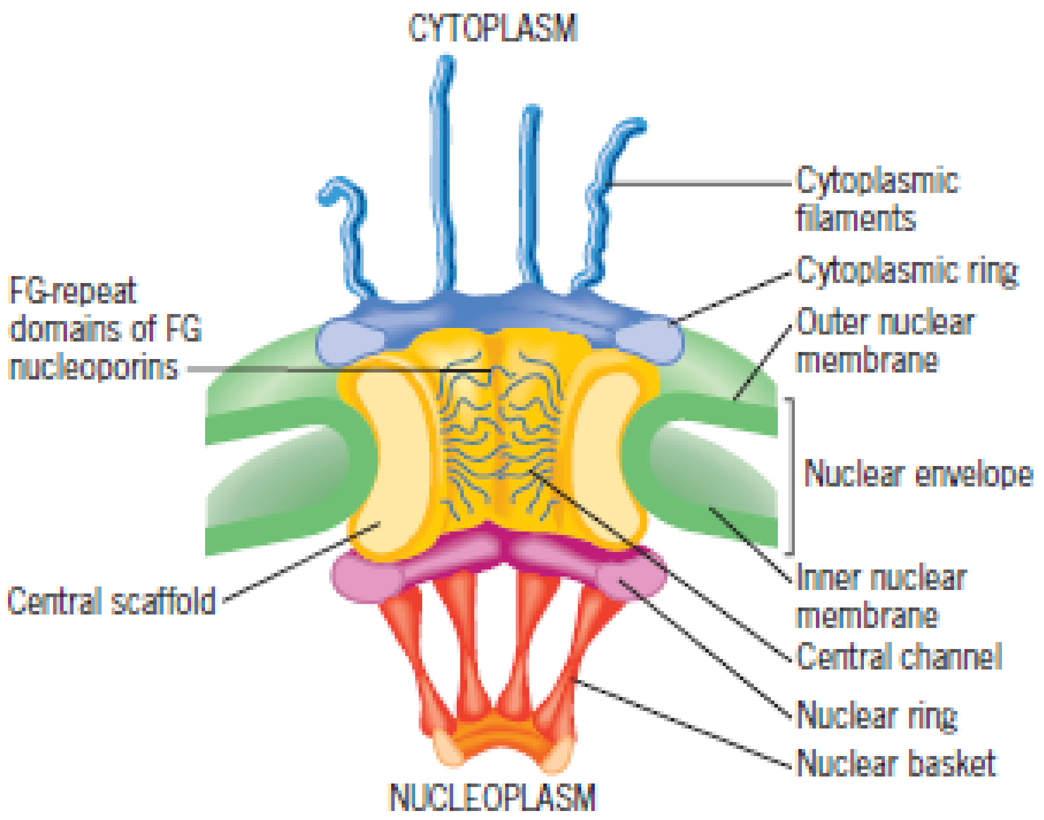
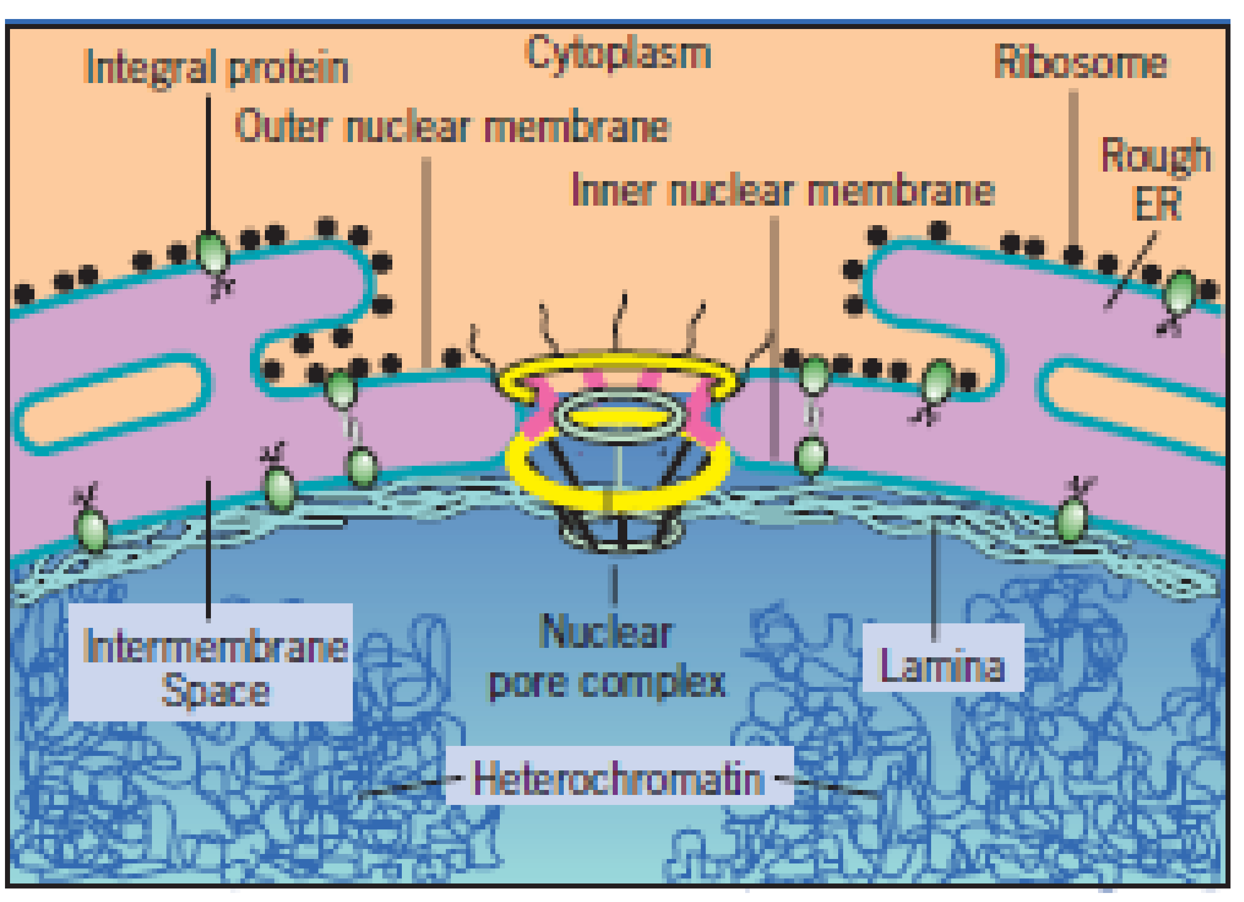


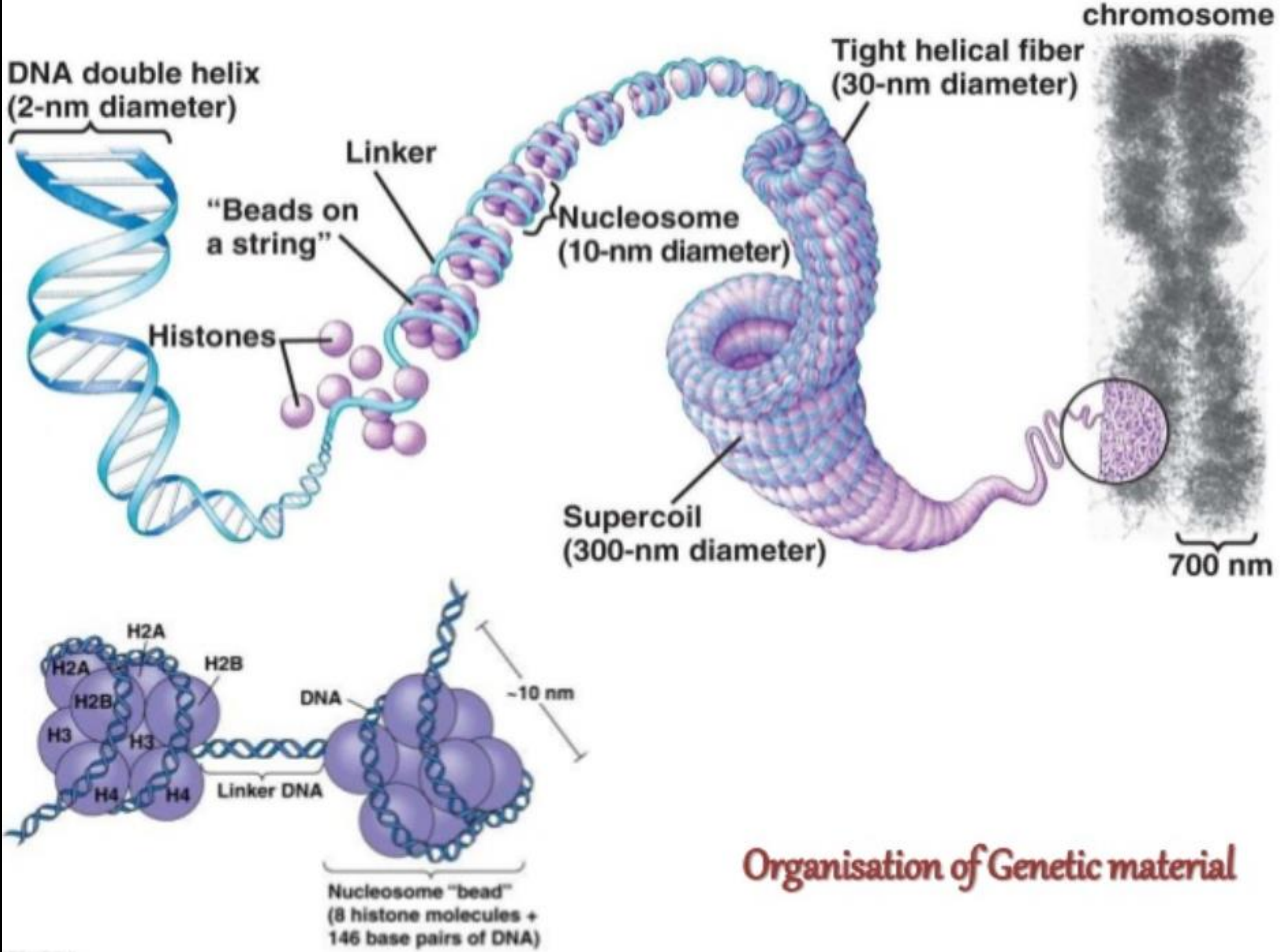
FIGURE 12.6 A model of a vertebrate nuclear pore complex (NPC). Three-dimensional representation of a vertebrate NPC as it is situated within the nuclear envelope. This elaborate structure consists of several parts, including a scaffold that anchors the complex to the nuclear envelope, a cytoplasmic and a nuclear ring, a nuclear basket, and eight cytoplasmic filaments. The FG-containing nucleoporins line the channel with their disordered FG-containing domains extending into the opening and forming a hydrophobic meshwork.



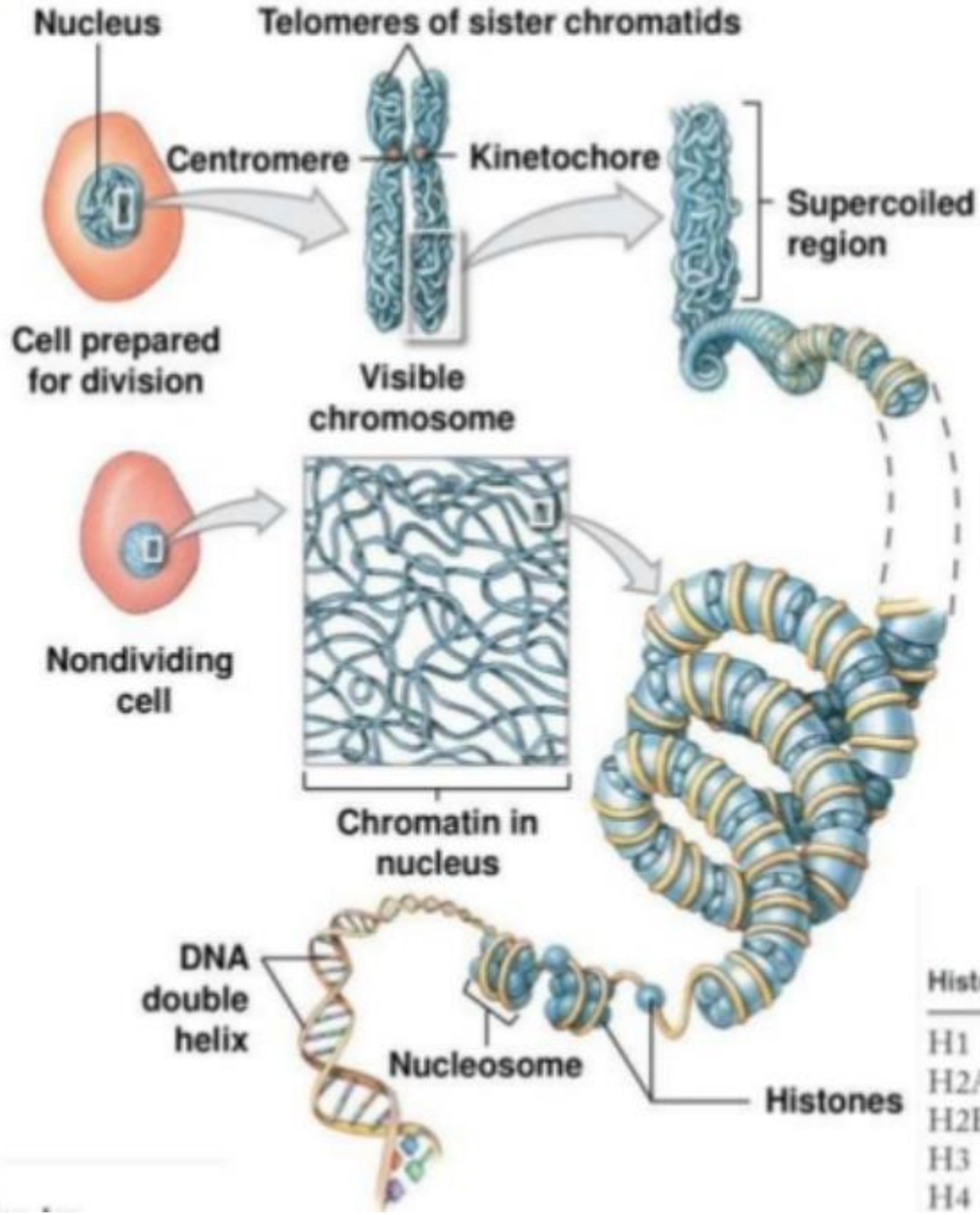
The Nuclear Envelope

(*a*) Schematic drawing showing the double membrane, nuclear pore complex, nuclear lamina, and the continuity of the outer membrane with the rough endoplasmic reticulum (ER).

Both membranes of the nuclear envelope contain their own distinct complement of proteins.



Organisation of Genetic material



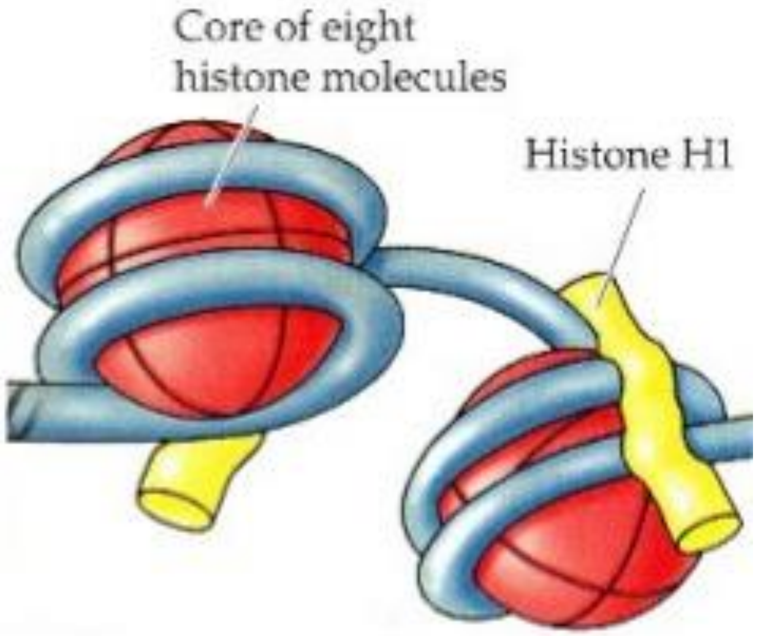
DNA exists in Chromatin form in the nucleus. The chromatin condenses to form Chromosomes during cell division.

Five classes of histones.

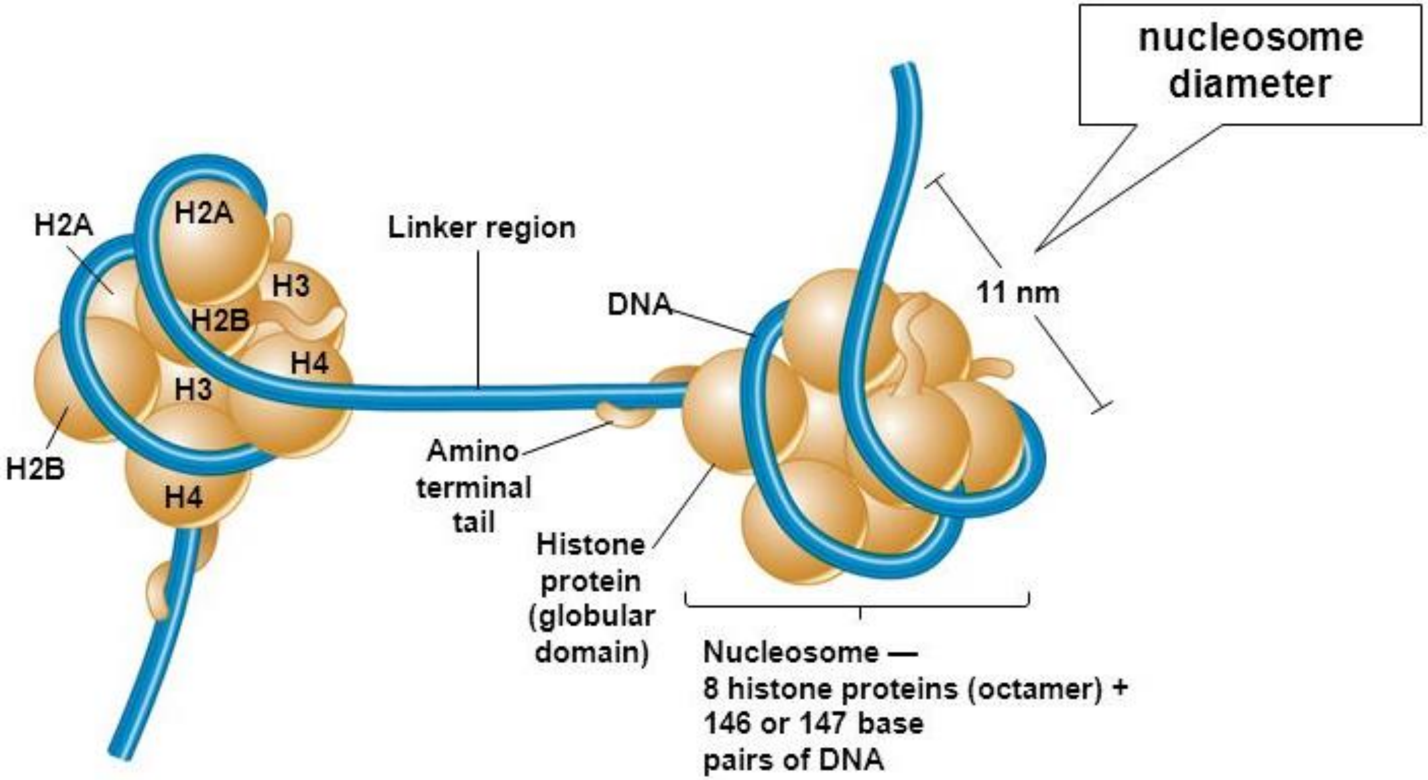
Histone	Number of residues	Mass (kDa)	%Arg	%Lys
H1	215	23.0	1	29
H2A	129	14.0	9	11
H2B	125	13.8	6	16
H3	135	15.3	13	10
H4	102	11.3	14	11

First level of packing: Nucleosome

- Nucleosome = DNA + core histones
- DNA wrapped twice around an octamer of core histones consisting of:
  - 2 of each core histone: H2A, H2B, H3, H4
  - Note: H1 is not part of the nucleosome, but is attached to the DNA near the nucleosome
- 10 nm in diameter



Nucleosomes shorten DNA ~seven-fold



(a) Nucleosomes showing core histone proteins

DNA Packaging in Eukaryotes

Model of packing of chromatin and the chromosome scaffold in metaphase chromosome

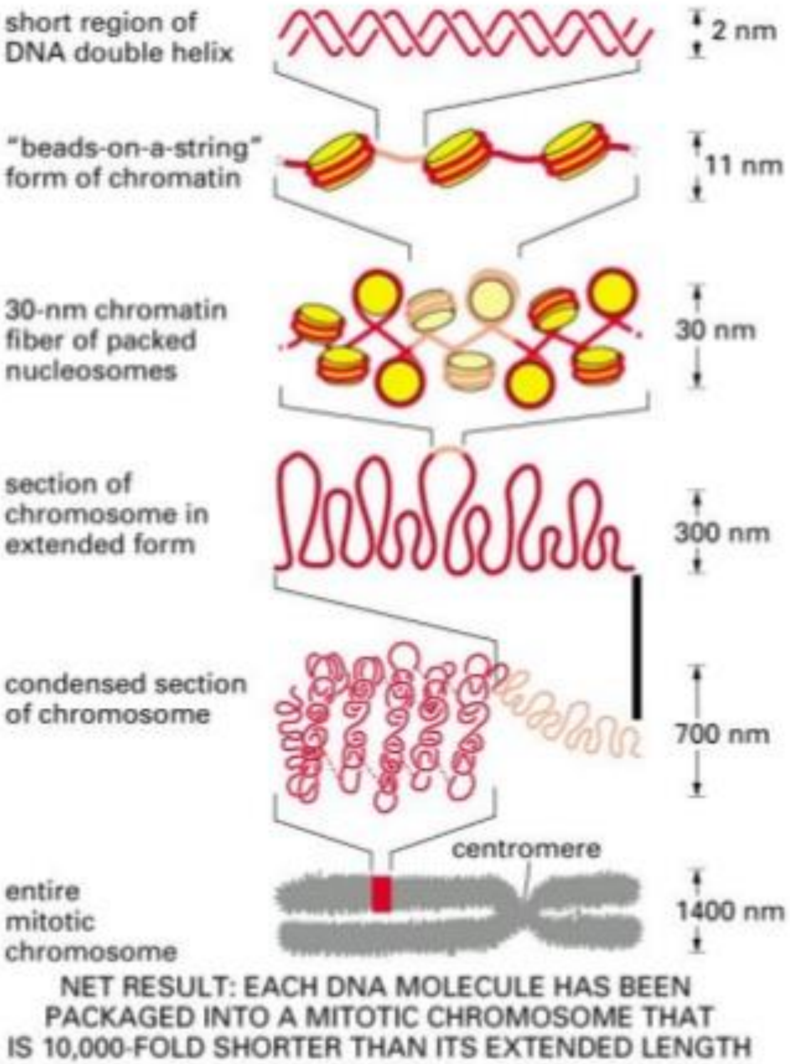


Figure 4–55. Molecular Biology of the Cell, 4th Edition.

DNA Packaging in Eukaryotes