VIVEKANANDA COLLEGE
THAKURPUKUR
KOLKATA - 700063

NAAC ACCREDITED “A” GRADE

Topic : GENETIC MATERIALS AND THEIR ORGANIZATION
Course title: Environmental Biotechnology
Paper: 6th (CC6)
Semester: 3
Unit : 2
Name of the teacher: **Sumana Mukherjee**
Name of the Department: Environmental Science

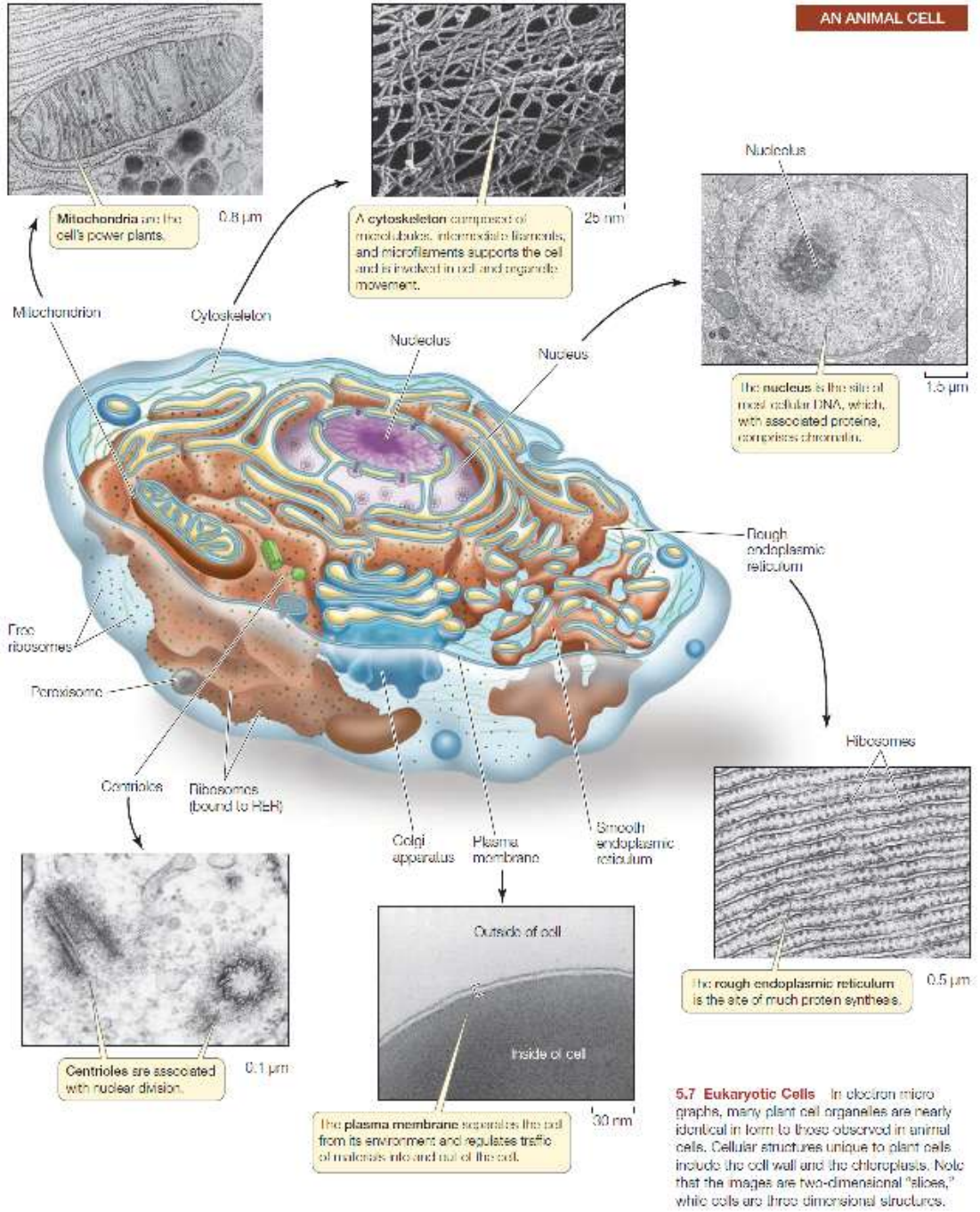
Genetic materials and their organization

Information storage, expression (Central Dogma of Molecular Biology) and sharing in Biological systems

By Sumana Mukherjee

Overview of a eukaryotic cell

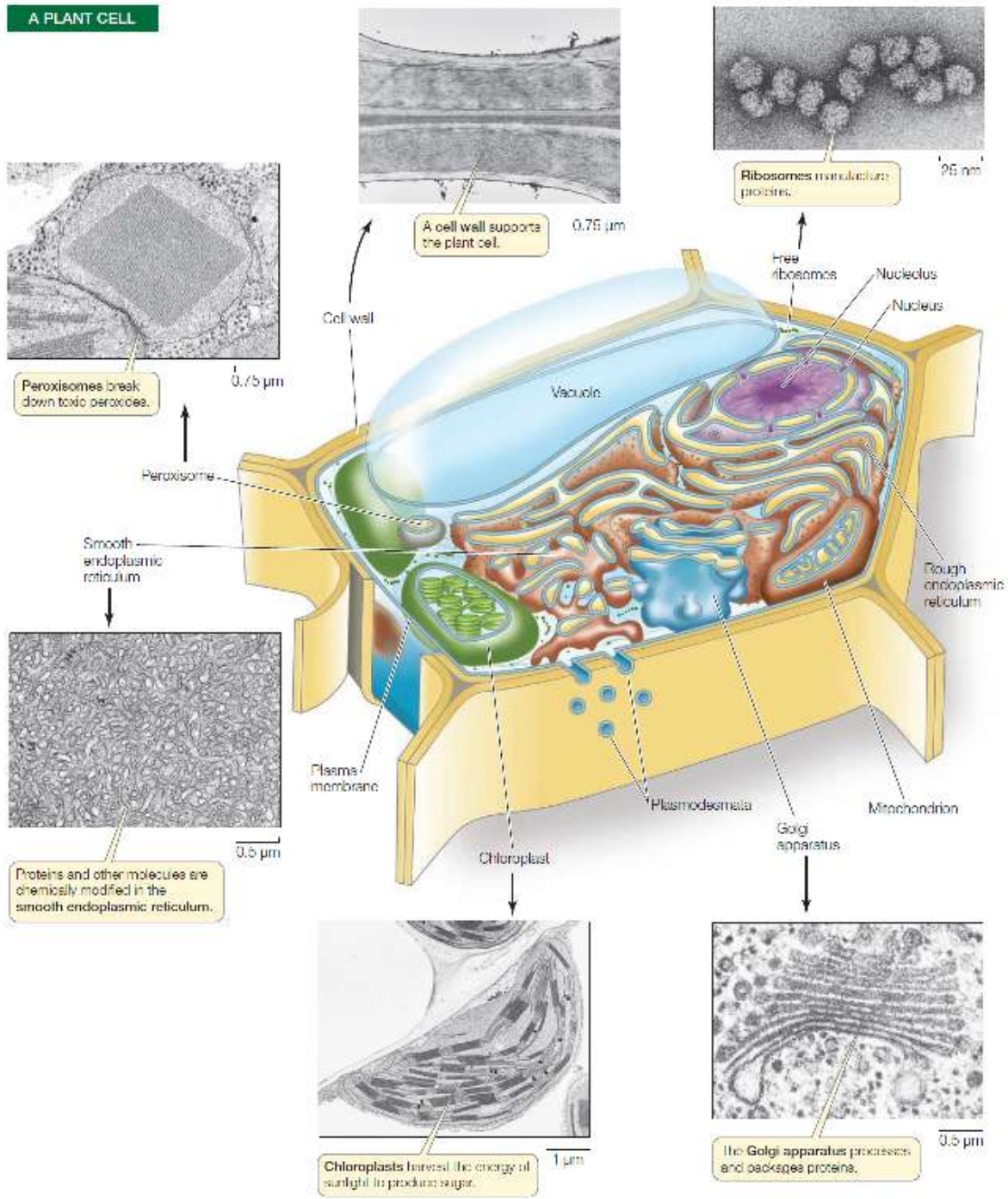
- Information and processing parts:
  - Nucleus stores the information in the form of chromatin material (chromosome:DNA)
  - Information decoding is done by RNA synthesis machinery that works inside the Nucleus to form mRNA
  - mRNA is transported out of the Nucleus and decoded to synthesize polypeptides by Ribosomes (usually associated with ER)
  - Polypeptides undergo folding and post-translational processing inside ER (mostly) forming mature proteins
  - Proteins, loaded in vesicles, are first gathered and then sorted at Golgi apparatus
  - Golgi targets proteins to their final destinations



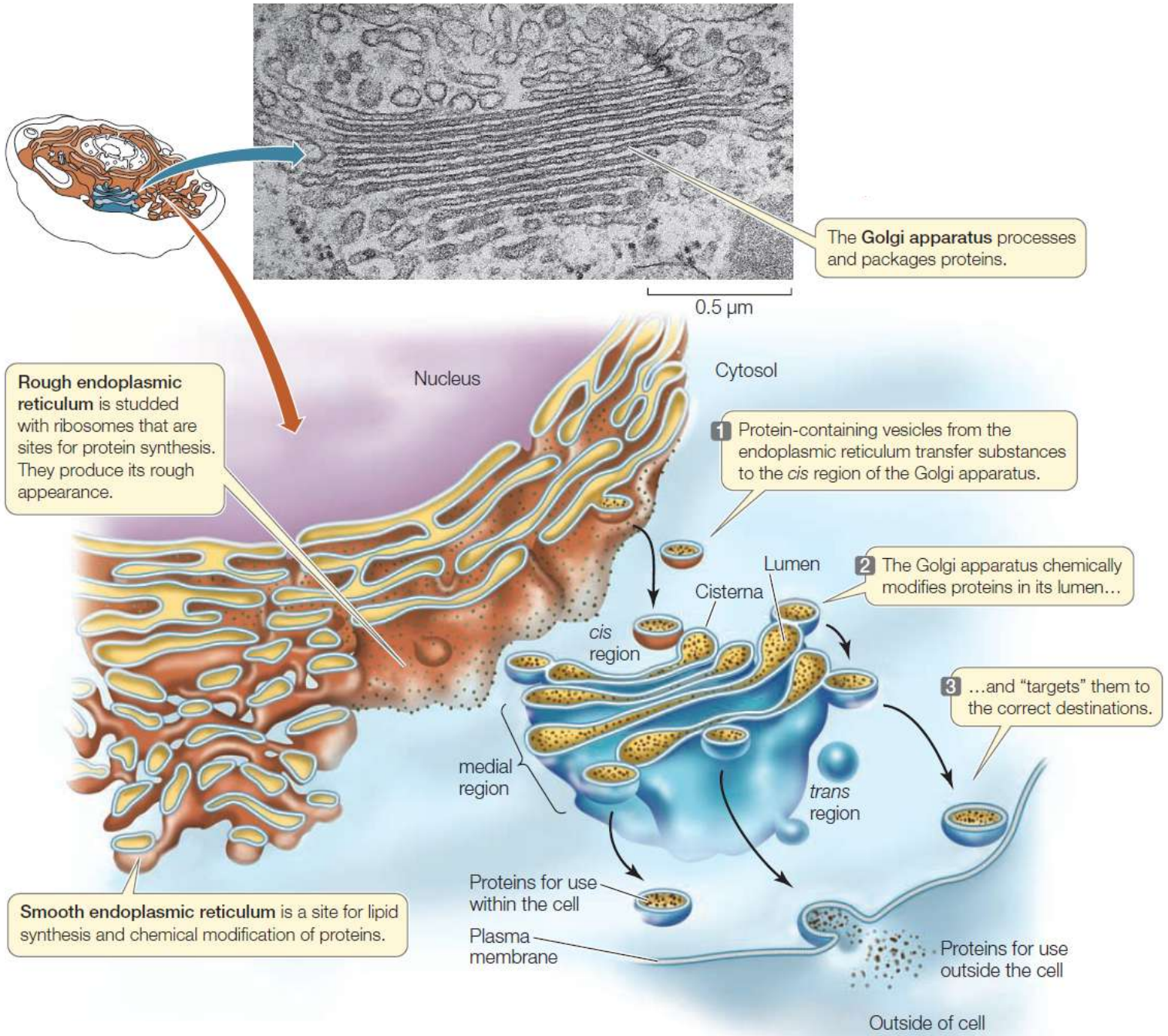
Organeller genomes

- Mitochondria (both in animal and plants) and Chloroplasts (in plants) have their own genetic material (DNA)
- Information needed for the functioning of these two organelles reside largely in their own respective genomes.
- However, a substantial part of the information also reside in the Nuclear genome. For example, mitochondria has several functional proteins which are made up of multiple domains. In many cases, within the same protein some domains are coded by mitochondrial genes while others are coded by nuclear genes.

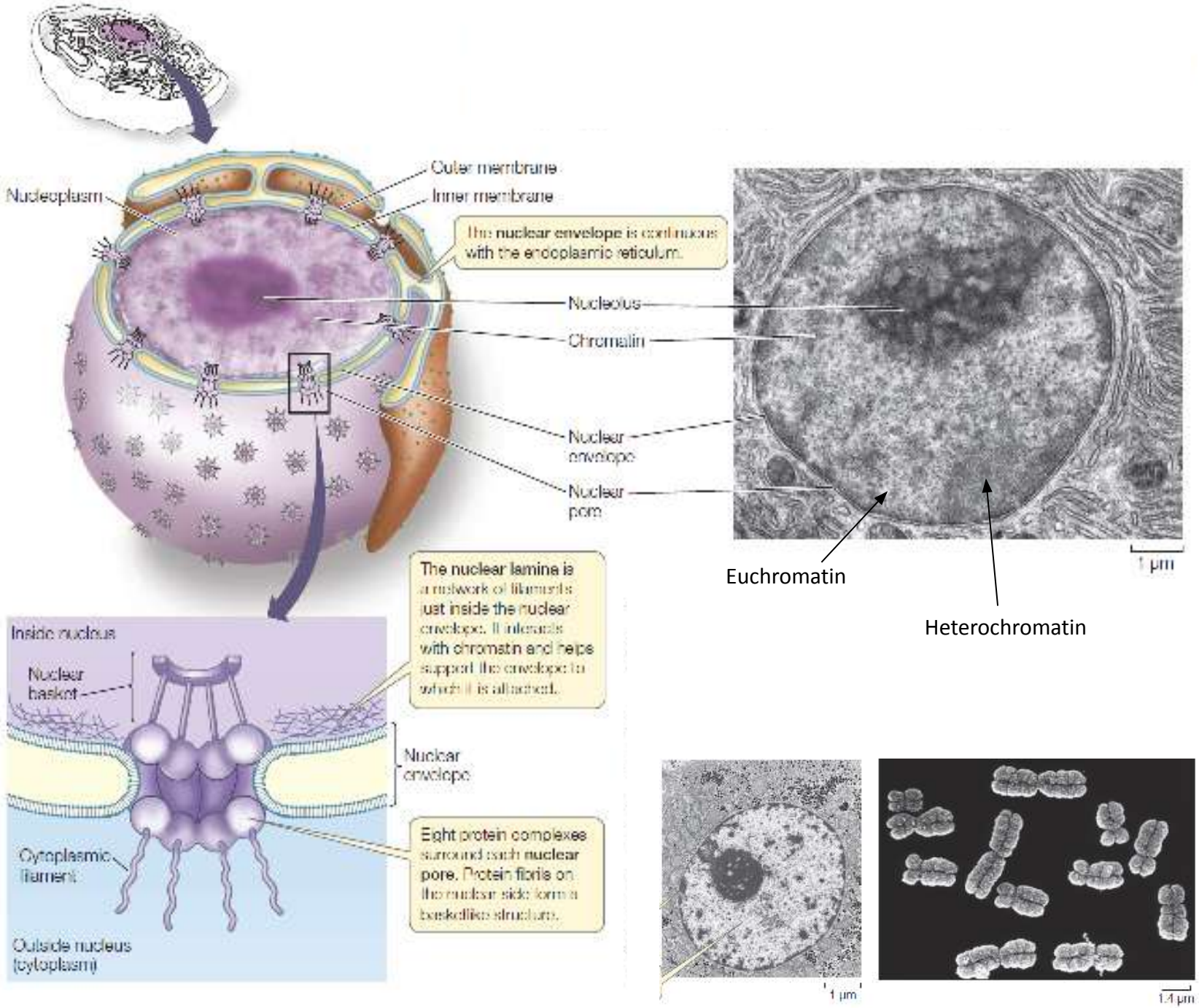
More to be discussed later (after prokaryotic genome)



Trajectory of proteins: from synthesis to distribution to target destinations

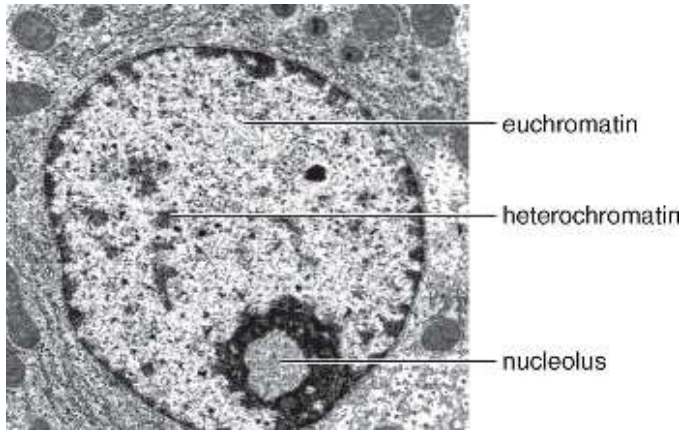


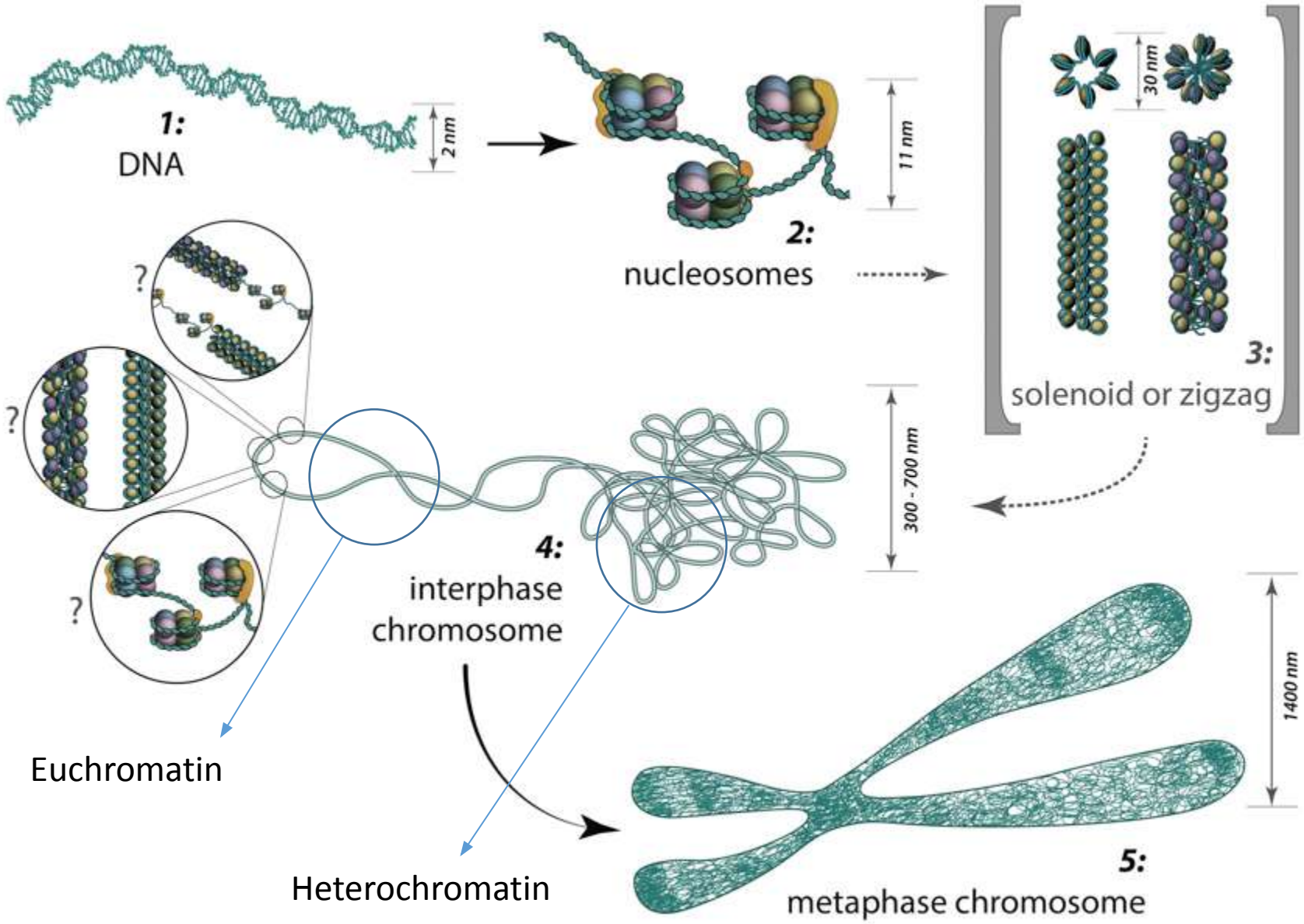
Nucleus: the information storage



Packaging genetic information in the chromosome:

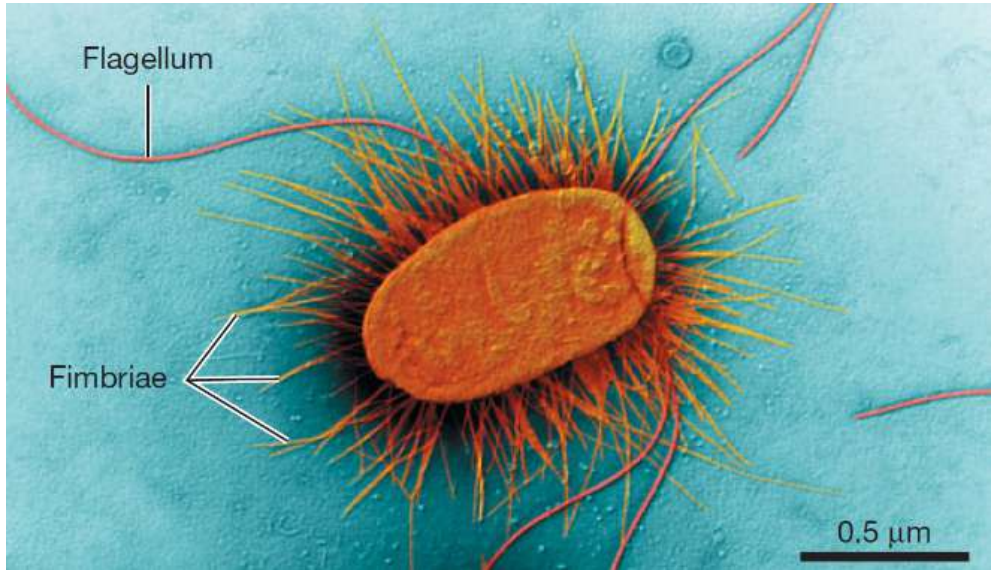
Structure of Eukaryotic chromosome

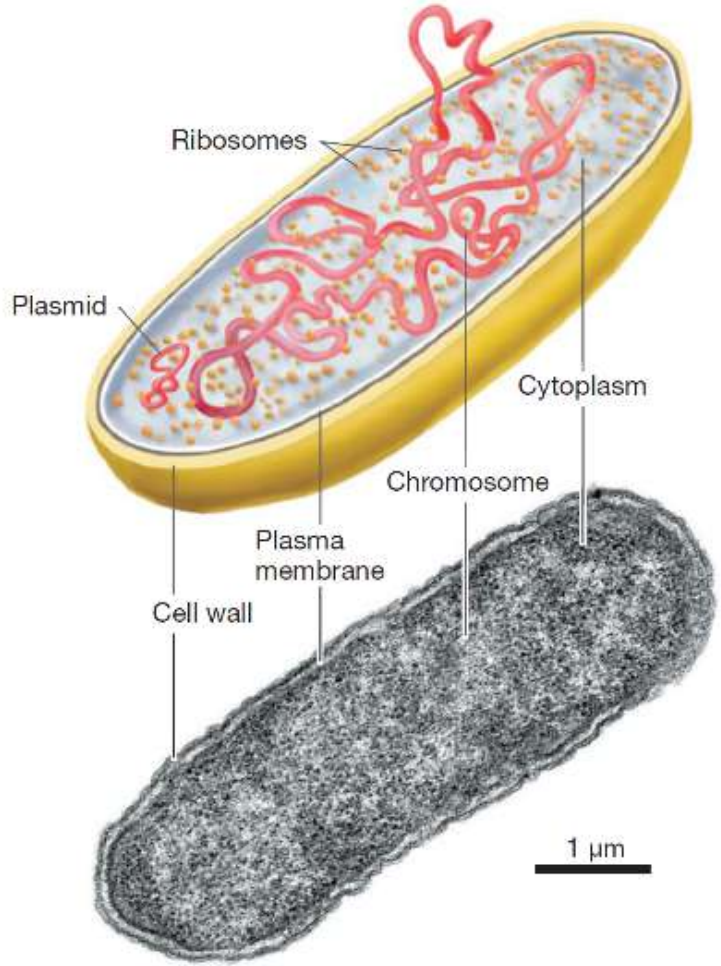


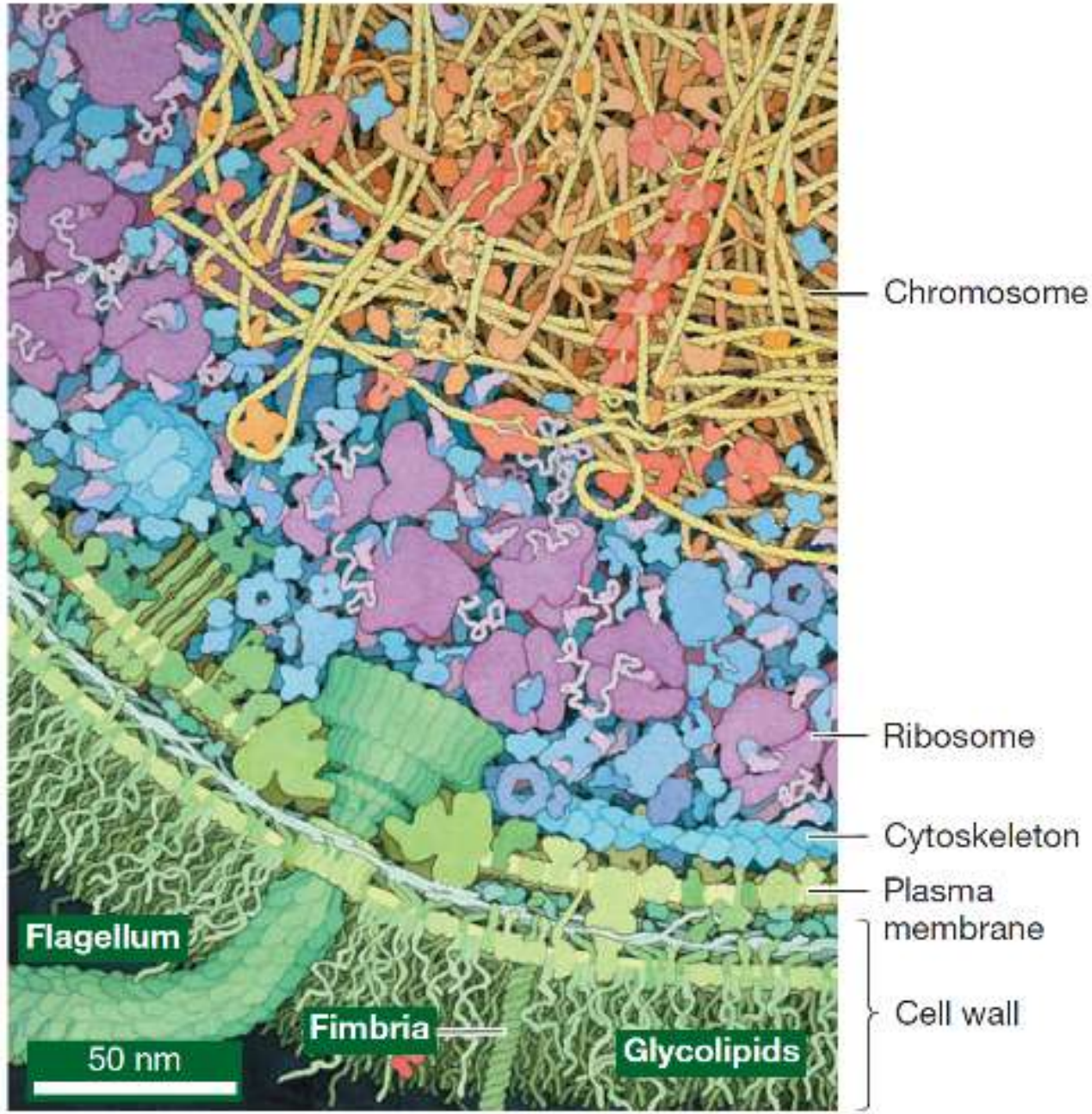


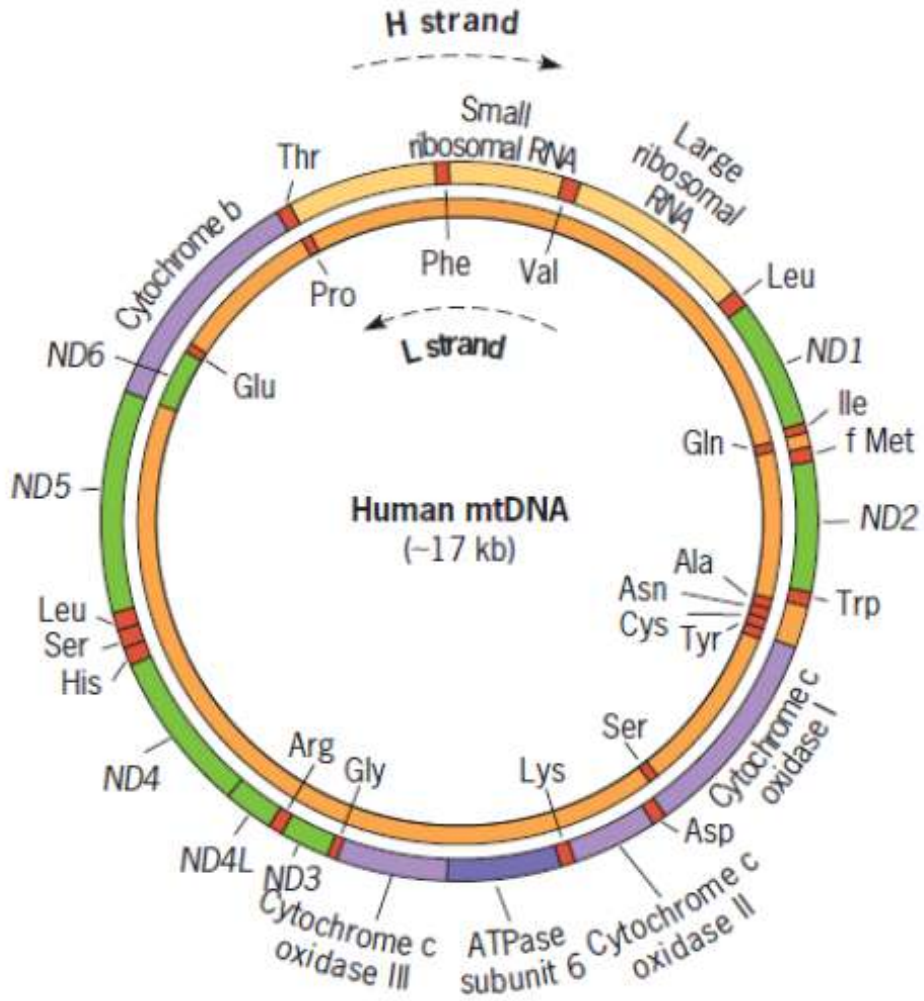
Bacteria and their genomes

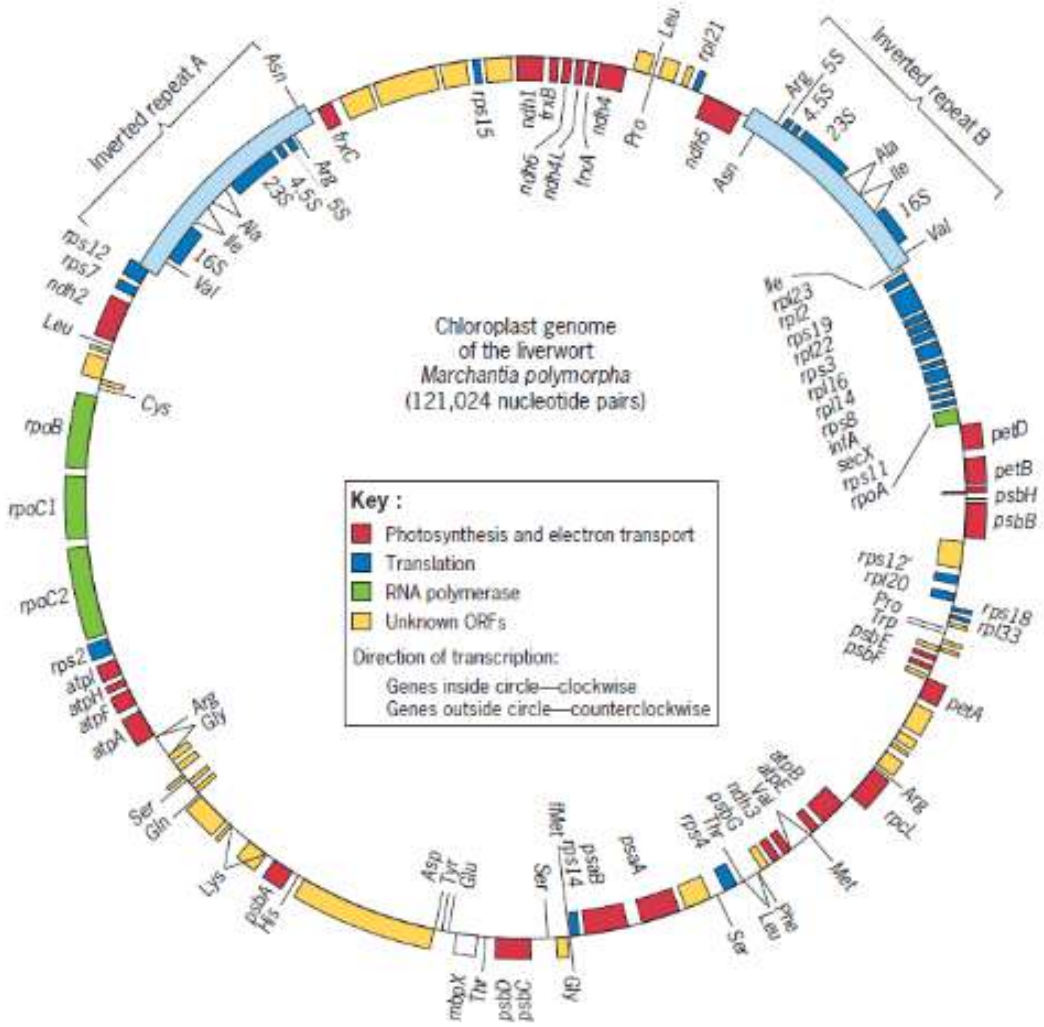
Prokaryotic cell and its chromosome



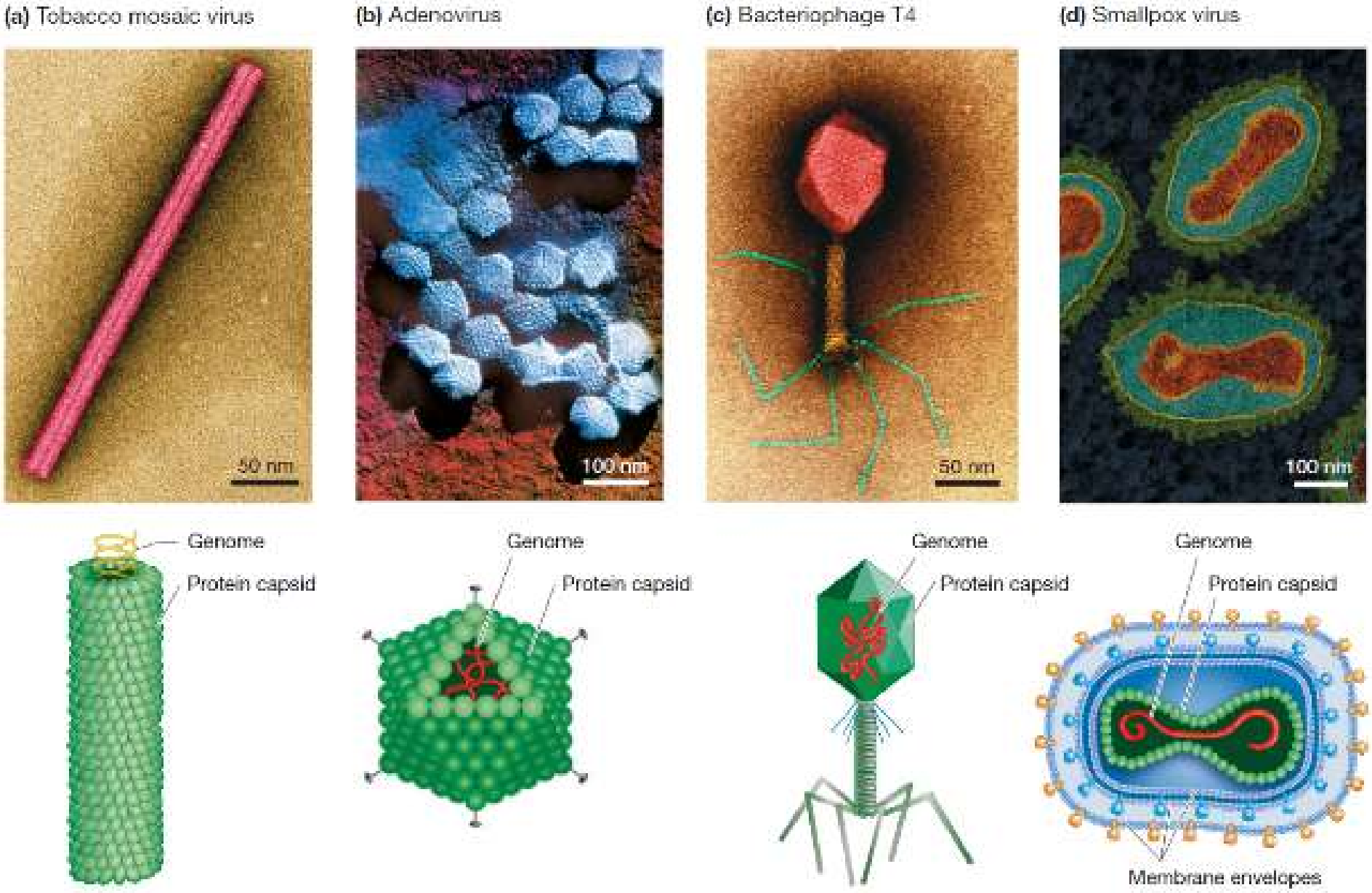



Chromosome
Ribosome
Cytoskeleton
Plasma membrane
Cell wall
Flagellum
Fimbria
Glycolipids
50 nm

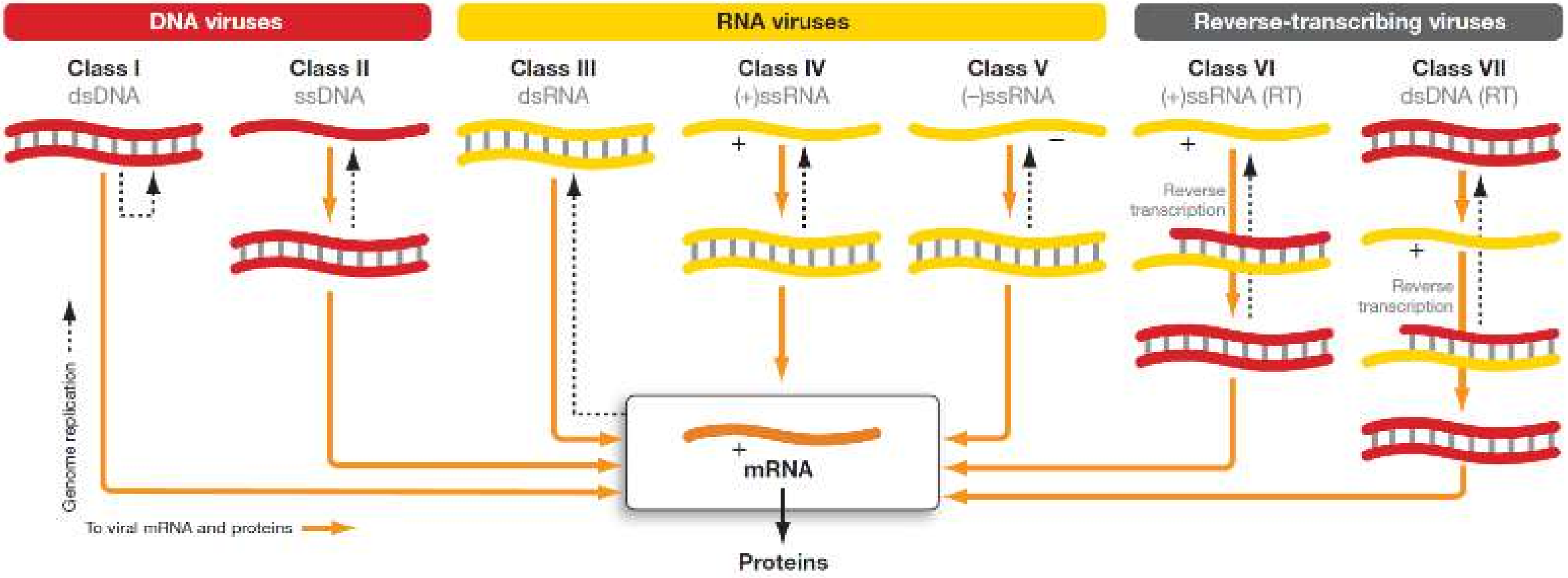

H strand
L strand
Human mtDNA
(~17 kb)
Small ribosomal RNA
Large ribosomal RNA
Thr
Phe
Val
Pro
Leu
ND1
Ile
f Met
Gln
ND2
Trp
Ala
Asn
Cys
Tyr
Cytochrome c oxidase I
Ser
Asp
Lys
Gly
Arg
ND3
ND4L
ND4
His
Ser
Leu
ND5
ND6
Glu
Cytochrome b
Cytochrome c oxidase III
ATPase subunit 6
Cytochrome c oxidase II


Chloroplast genome
of the liverwort
Marchantia polymorpha
(121,024 nucleotide pairs)
Key :
Photosynthesis and electron transport
Translation
RNA polymerase
Unknown ORFs
Direction of transcription:
Genes inside circle—clockwise
Genes outside circle—counterclockwise
Inverted repeat A
Inverted repeat B

Viruses and their genomes

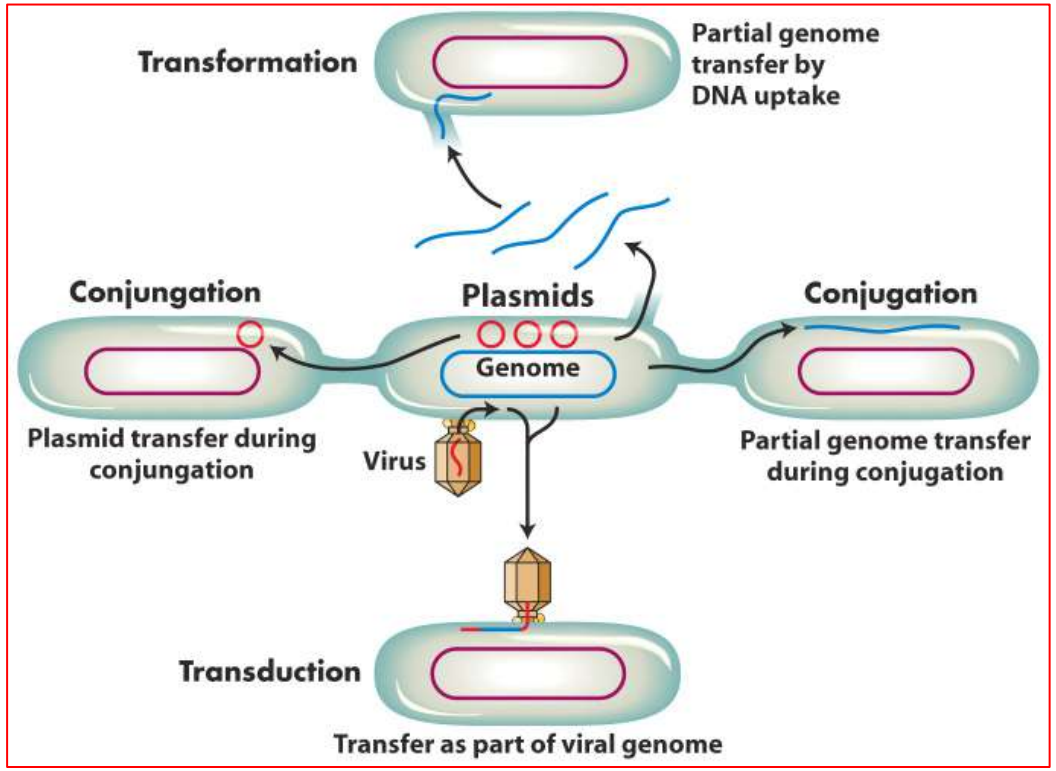

(a) Tobacco mosaic virus
(b) Adenovirus
(c) Bacteriophage T4
(d) Smallpox virus
50 nm
100 nm
50 nm
100 nm
Genome
Protein capsid
Genome
Protein capsid
Genome
Protein capsid
Genome
Protein capsid
Membrane envelopes

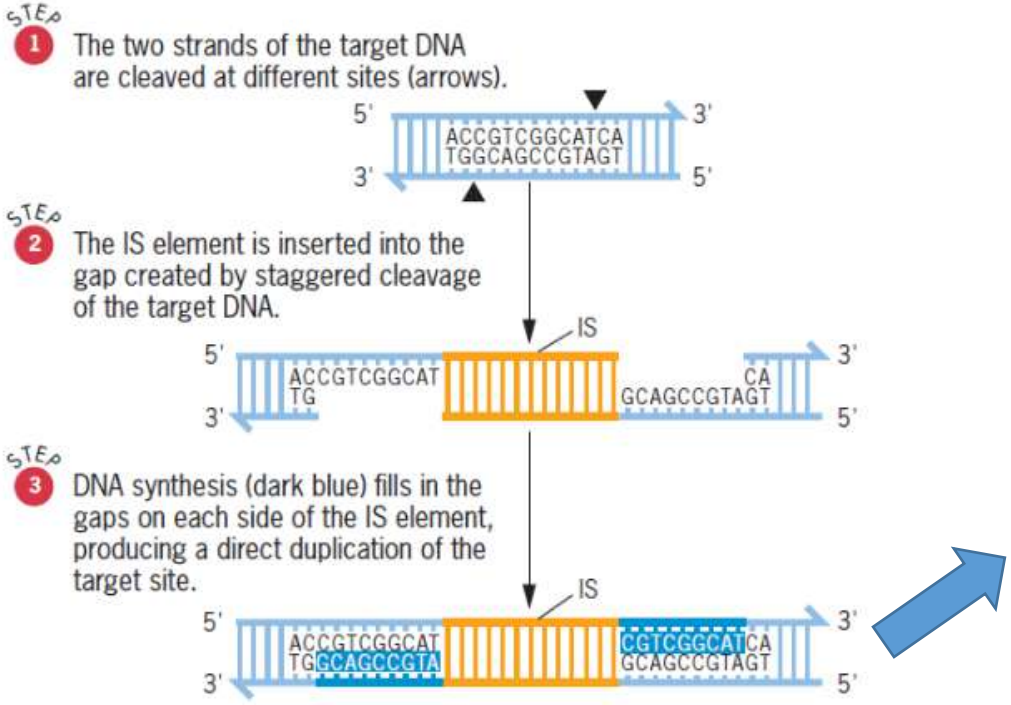
The Seven Different Strategies for Expression of Viral Genetic Material Converge on the Translation of mRNA

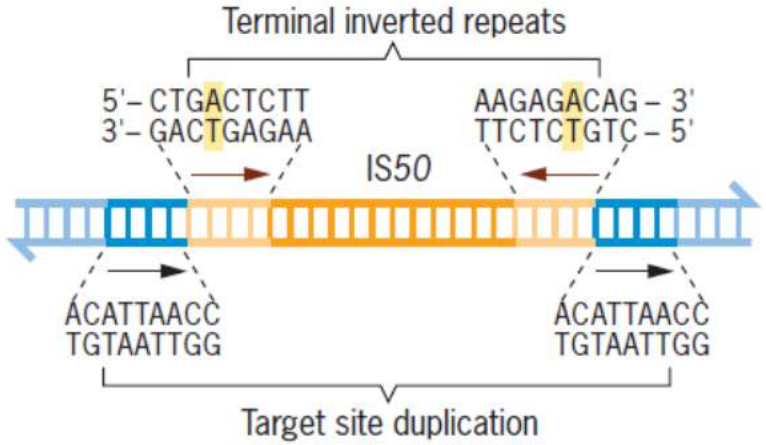


Mobile DNA

- Horizontal gene transfer in Bacteria
- Transposable genetic elements

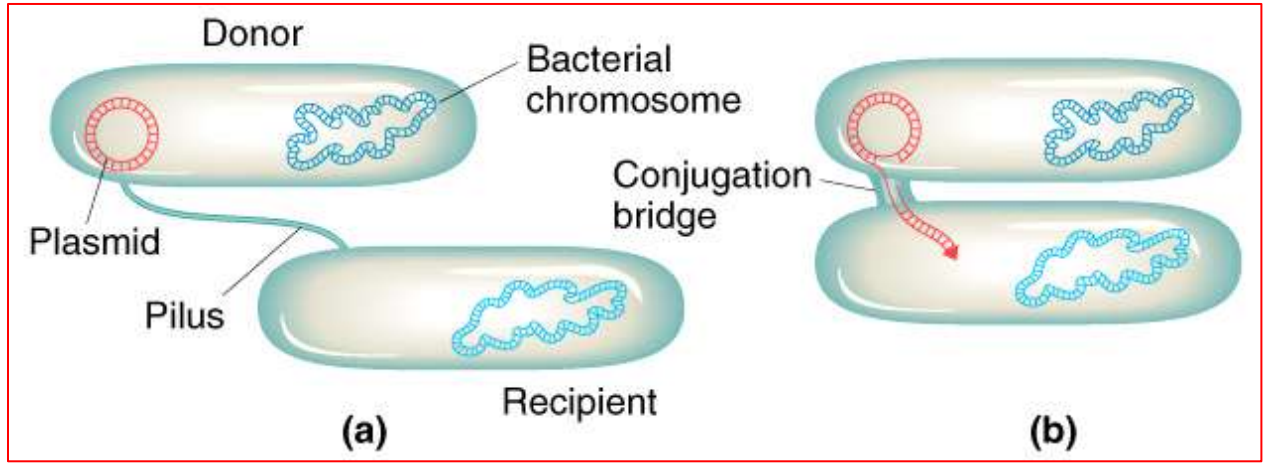




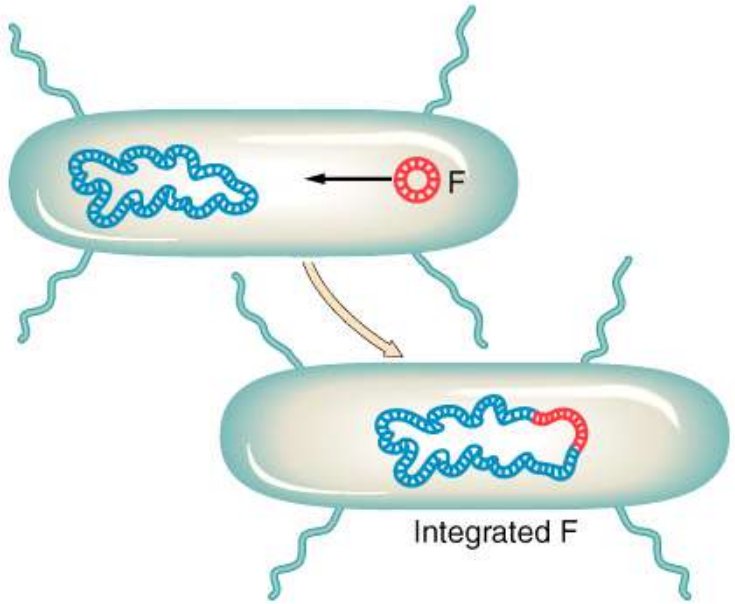


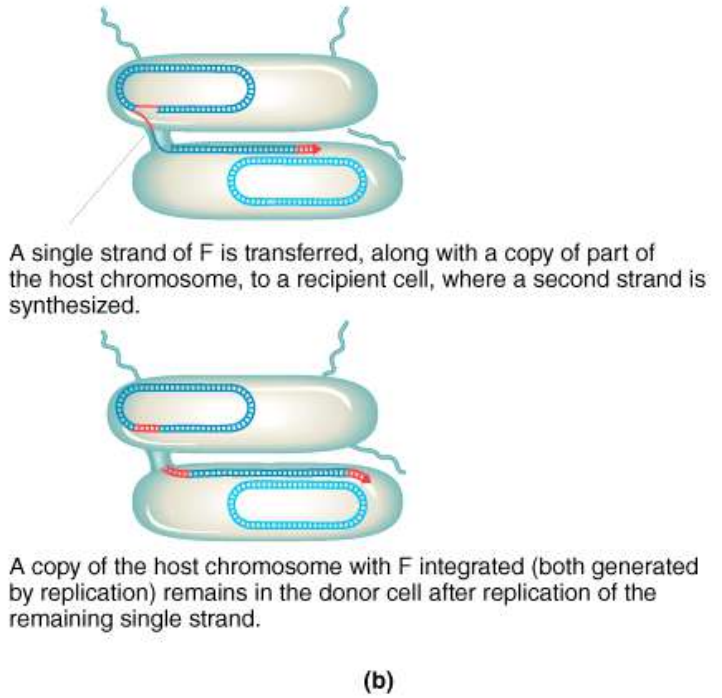
Bacterial conjugation

Transfer of F-plasmid only

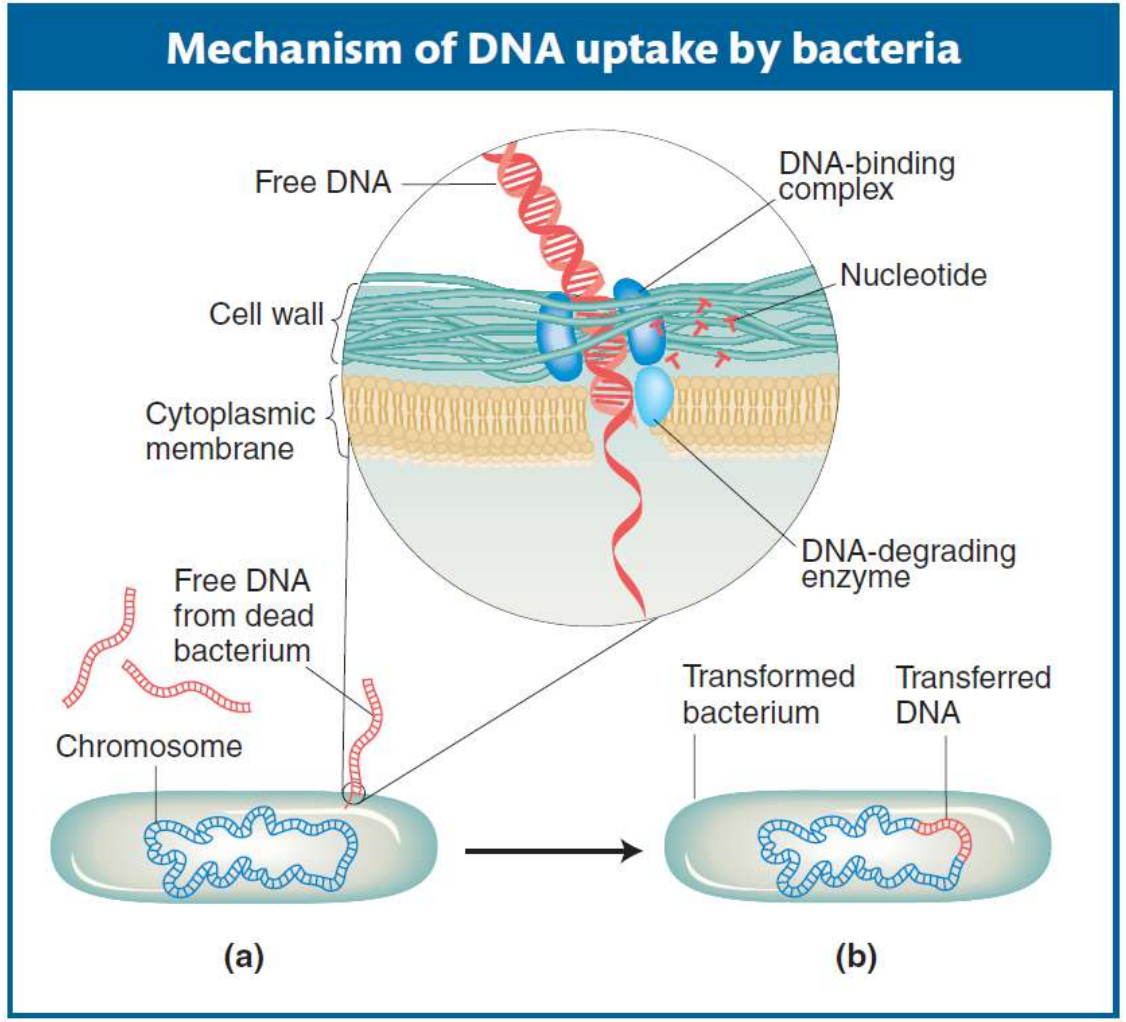


If F-plasmid integrates with the chromosomal DNA it can transfer larger parts of chromosomal DNA as well



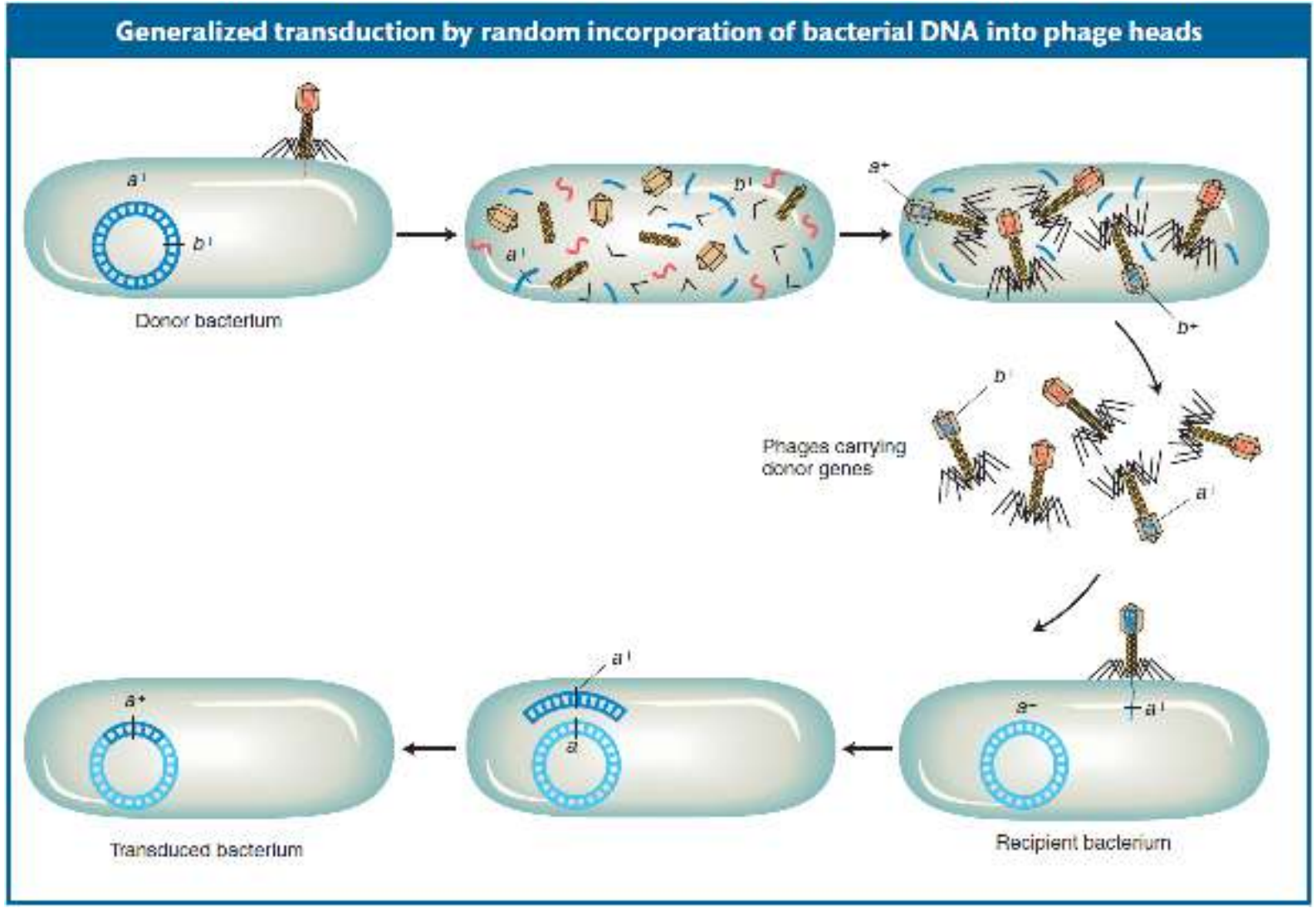


Bacterial transformation



Phage viruses can act as vectors transferring small pieces of bacterial DNA from one bacteria to another

Transduction (Generalized)



Happy Reading..