100.000.000.000.000

E’ il numero di cellule nel nostro corpo

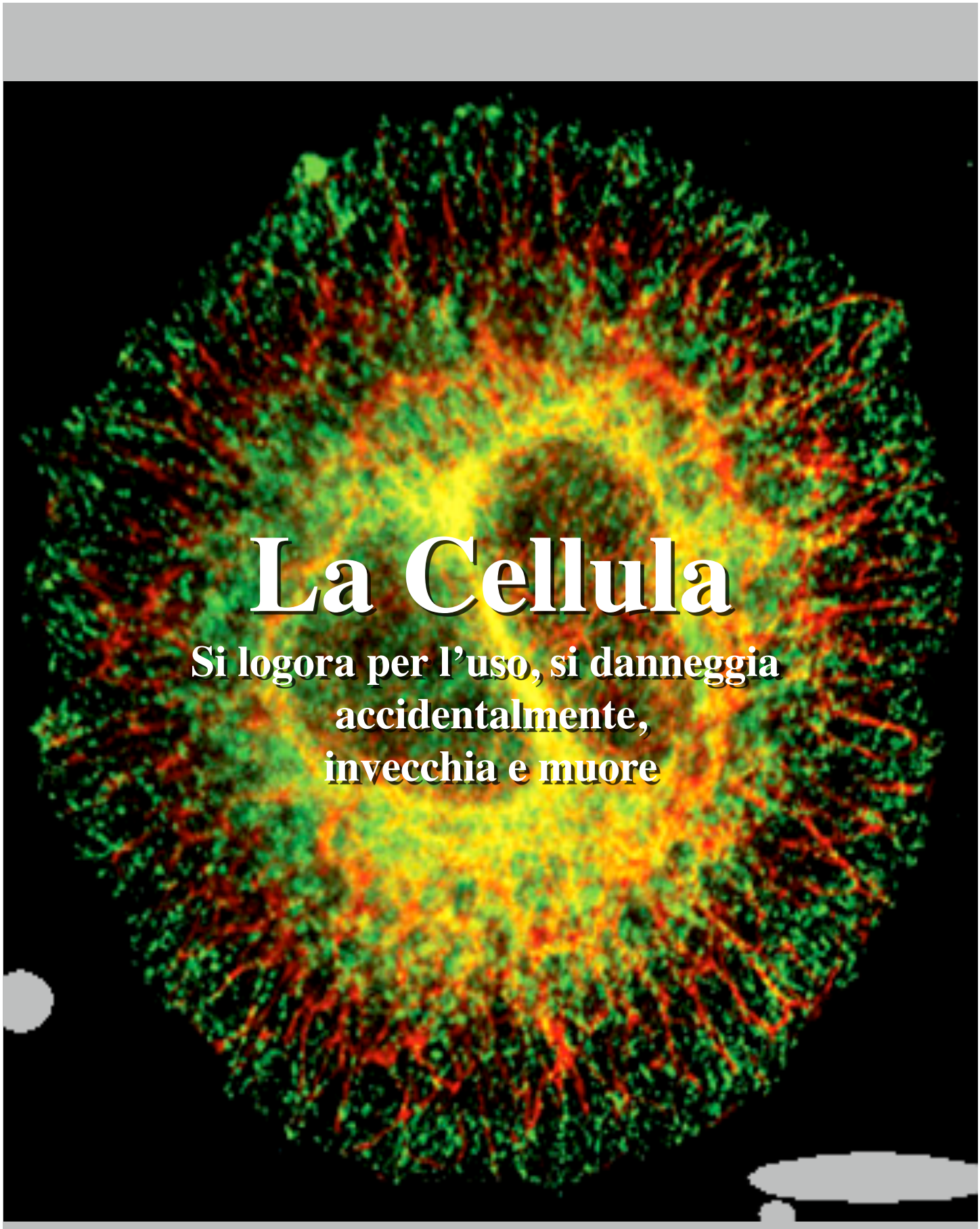
200

Sono i diversi tipi diversi di cellule presenti nel nostro corpo

6,5 cm^2 di pelle

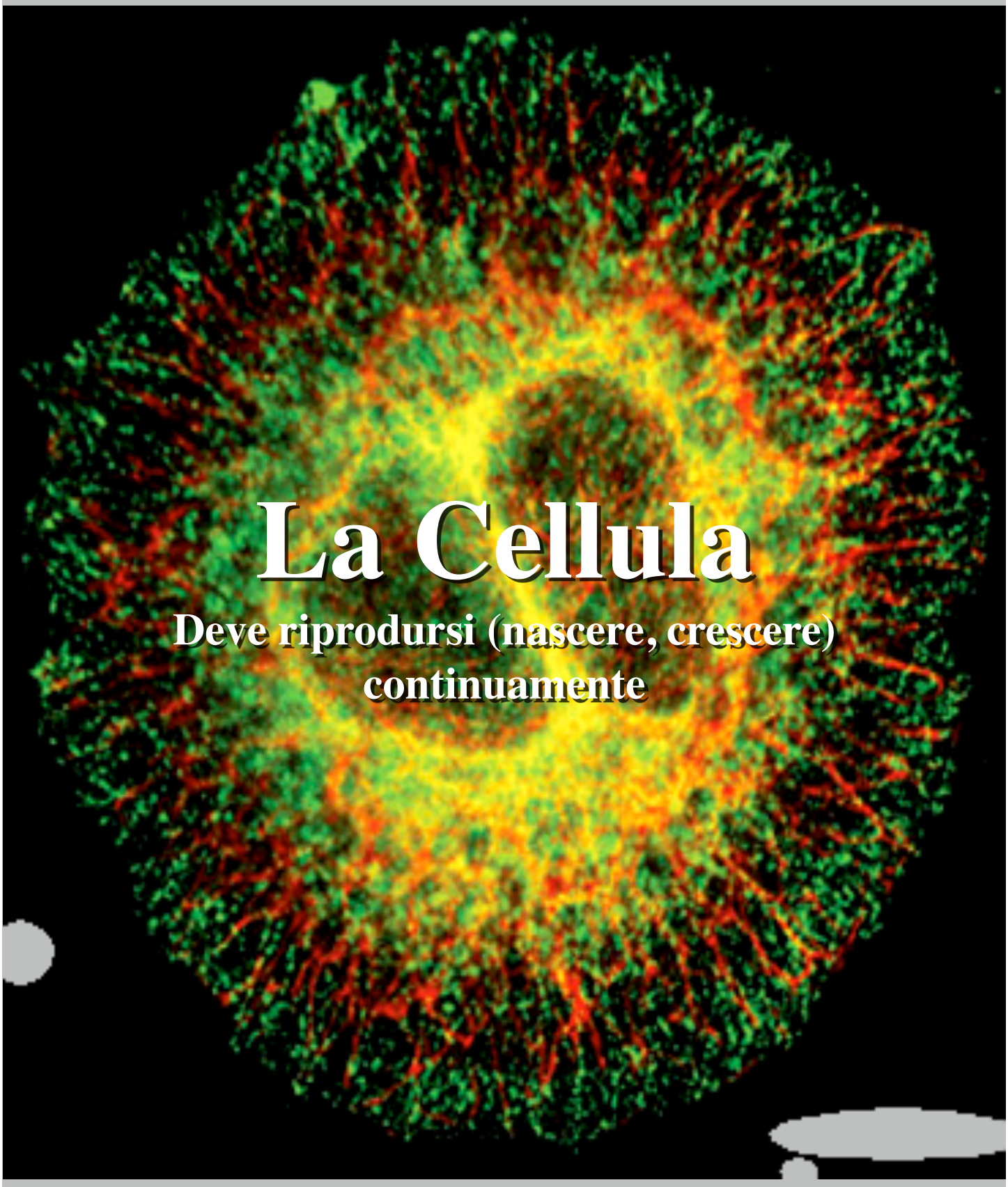
Contengono 3.000.000 di cellule (tra cui 1300 cellule nervose) che formano

6 mt. di vasi sanguigni, 3,5 mt. di nervi, e 100 ghiandole sudoripare



La Cellula

Si logora per l'uso, si danneggia accidentalmente, invecchia e muore



La Cellula

Deve riprodursi (nascere, crescere) continuamente

2 kg

E’ la quantità di peso corporeo costituita da cellule morte

3 mesi

E’ il tempo che impieghiamo per sostituire il nostro scheletro

1.000

E’ la quantità di volte che ricostruiamo
gli strati esterni della nostra pelle nel corso della vita

30 giorni

E’ la vita media di una cellula

4 mesi

E’ la vita media di un globulo rosso

10 anni

E’ la vita media di una cellula del fegato

10.000

Sono le cellule nervose che nascono ogni giorno nel nostro cervello

25.000.000

Sono le cellule che nascono ogni secondo nel nostro corpo

2.000.000

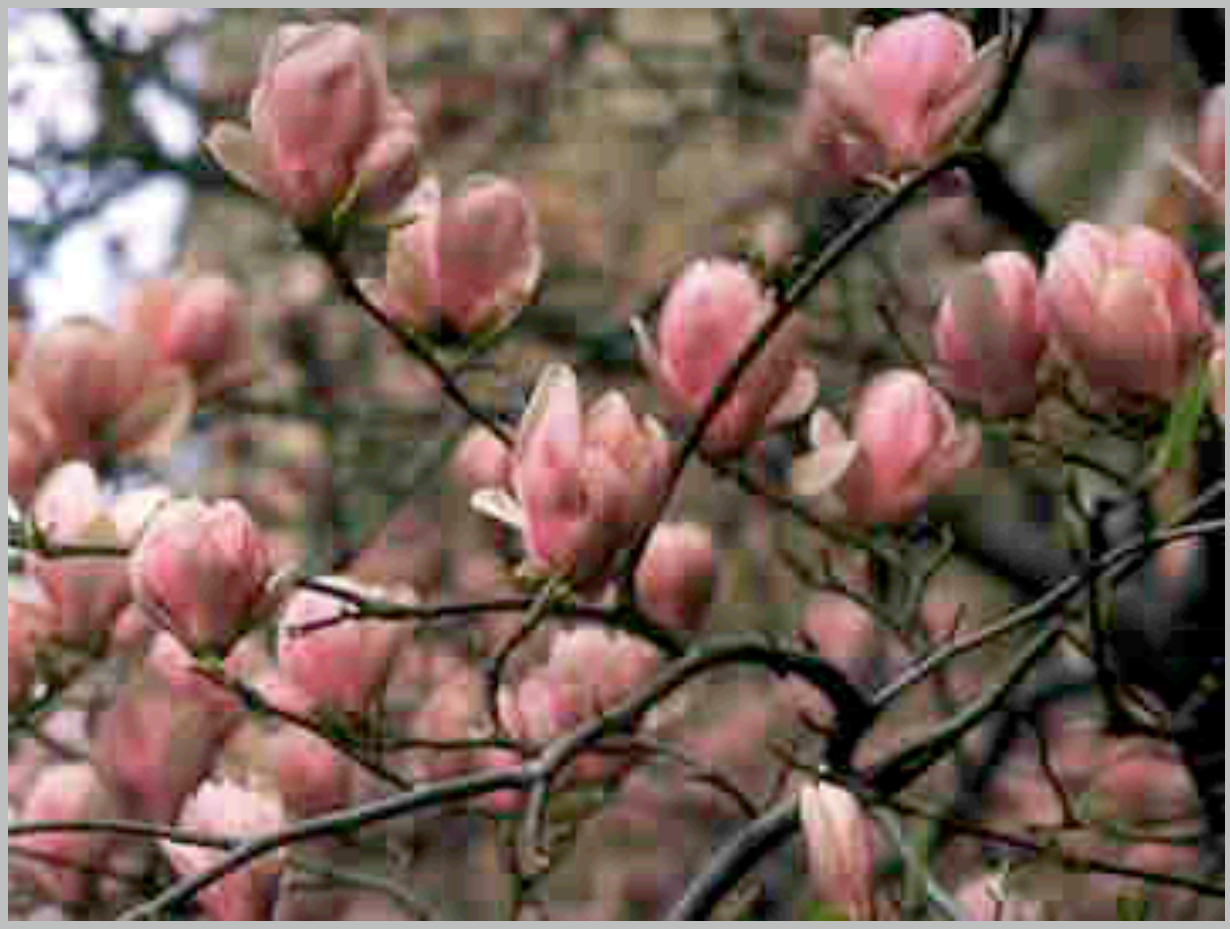
Sono i globuli rossi che nascono ogni secondo nel nostro corpo

500.000.000

Sono le cellule della nostra pelle che muoiono ogni giorno

100.000.000.000.000.000

E’ il numero medio di duplicazioni cellulari che determinano l'insorgenza di un tumore maligno



Xenopus laevis

Theodore Schwaan

Teoria cellulare (1839)

1) Tutti gli organismi sono composti da una o piu' cellule

2) La cellula e' l'unita' strutturale della vita

Rudolph Virchow (1858)

3) Le cellule possono avere origine solo per divisione di cellule preesistenti

Acetabularia acetabulum

Tallo costituito da un'unica cellula che consta di un pedicello di 2-6 cm, portante all'apice un cappello di circa 1 cm di diametro. Ciascun raggio del cappello rappresenta un ramo laterale che comunica direttamente con l'asse. L'organizzazione è quindi sifonale. Il nucleo è localizzato nella parte basale rizoidale della cellula.

Diversi tipi di cellule

Due tipi di cellule

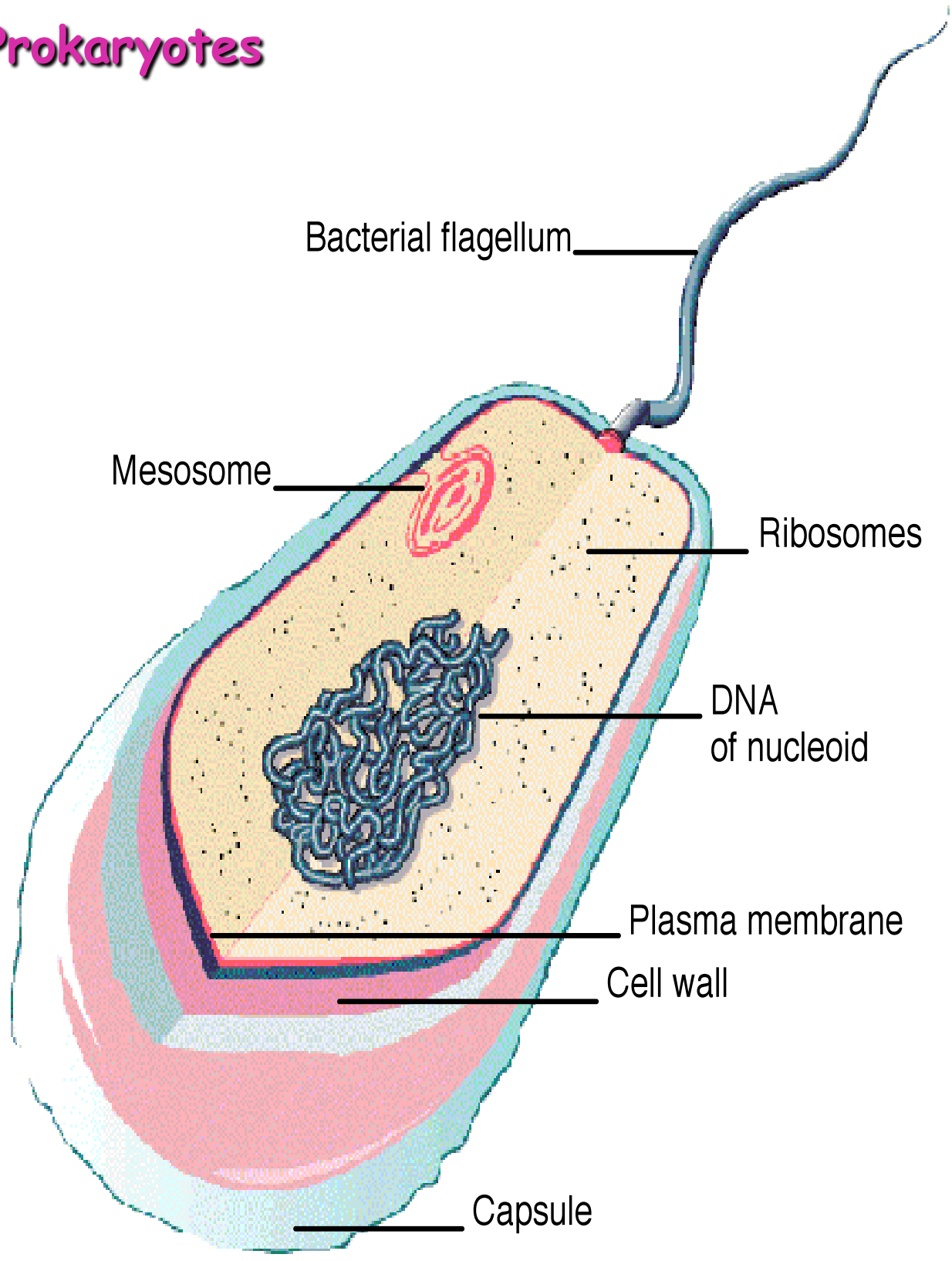
Cellule procariote

- Meno complesse
- Organismi unicellulari

Cellule eucariote

- Possiedono un nucleo circondato da membrana
- Possiedono anche altri norganelli
- Organismi uni- o pluri-cellulari

Prokaryotes

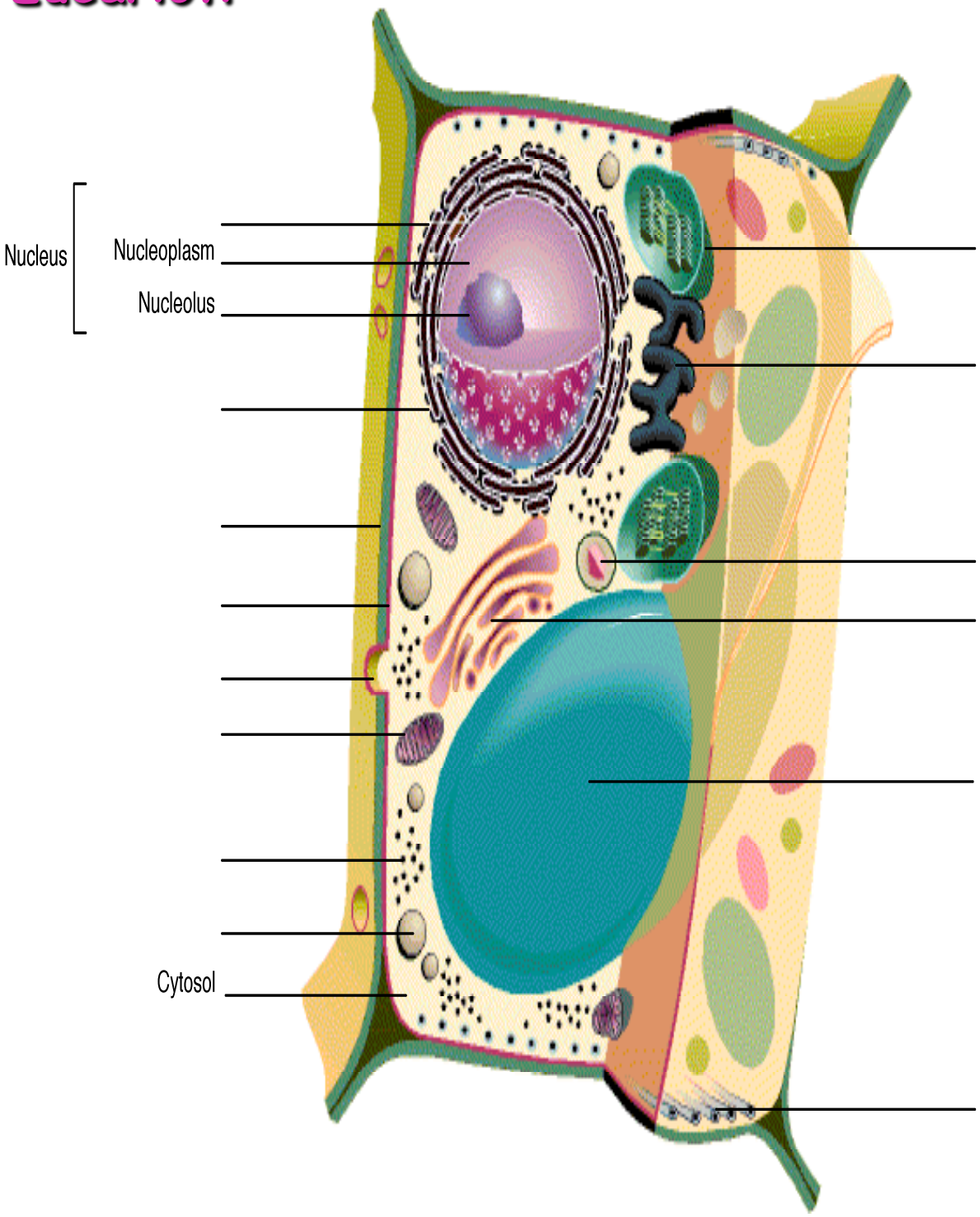


(a)

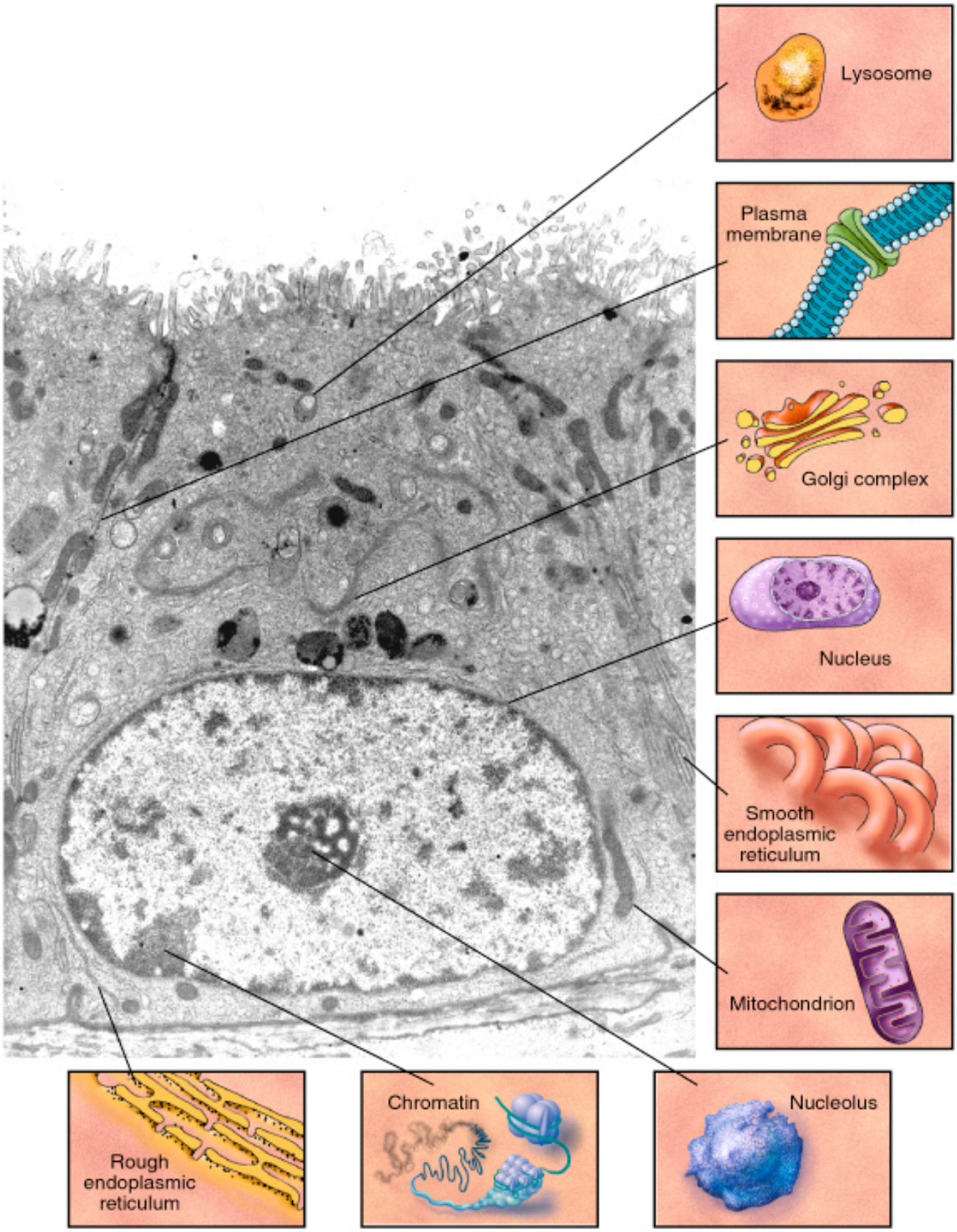
Escherichia coli

PROCARIOTI

Eucarioti



(b)



Diverse caratteristiche

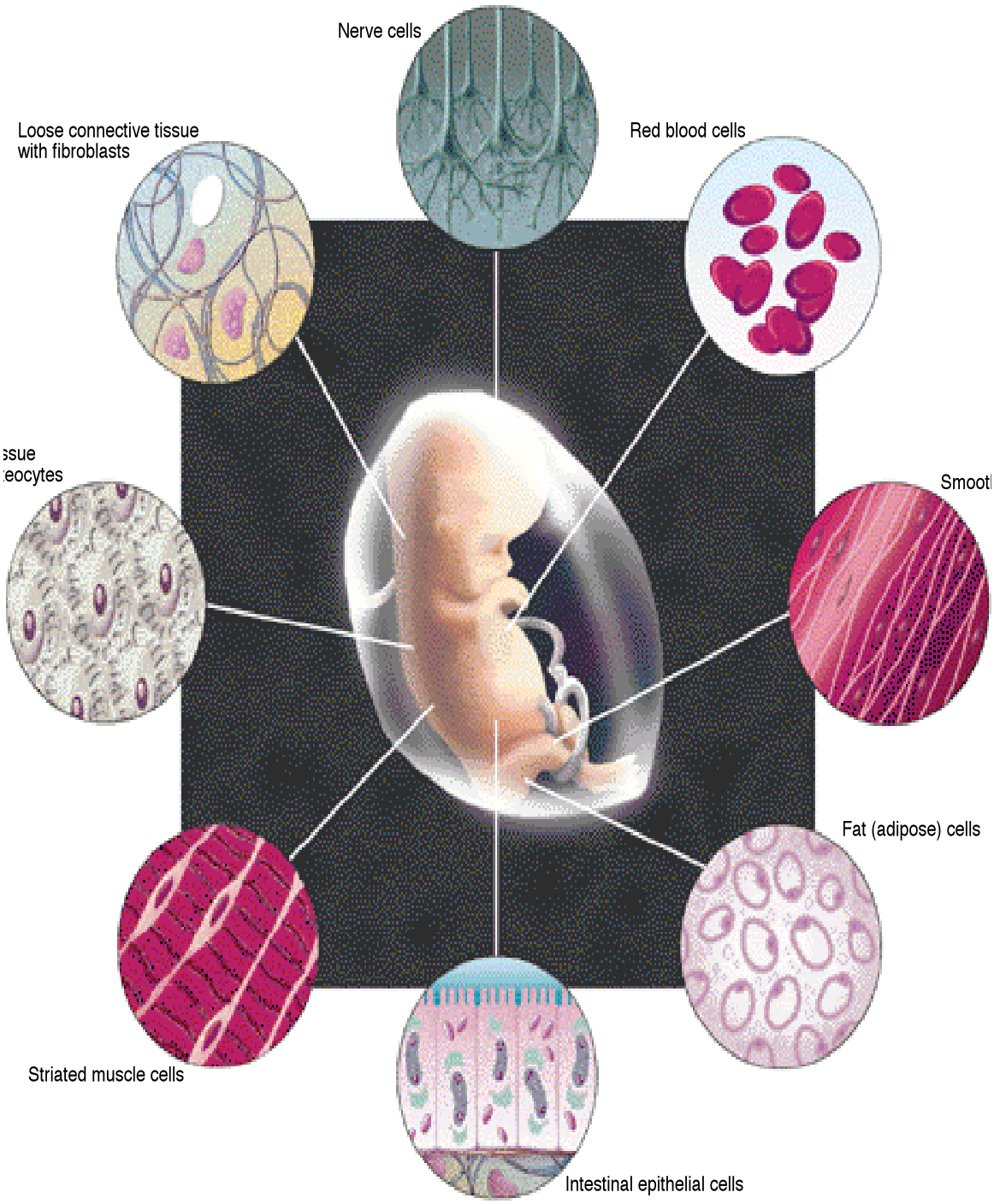
Cell Division

- Organismi procarioti<: dupplicano il DNA, non c'e' riproduzione sessuata

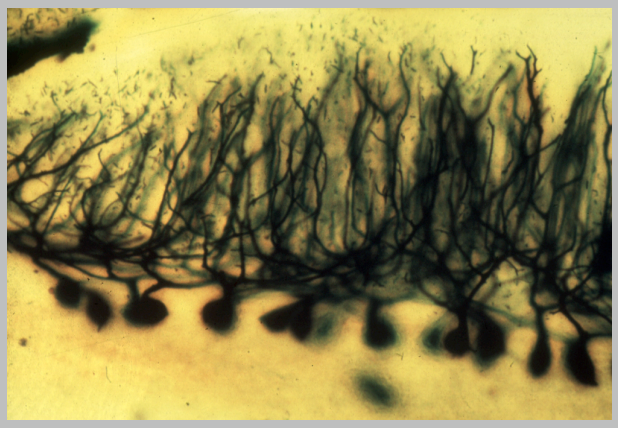
Mitosis

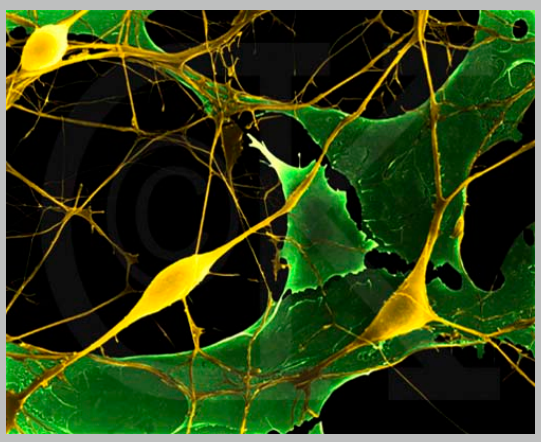
- Organismi eucarioti: possono avere riproduzione sessuata

Meiosis

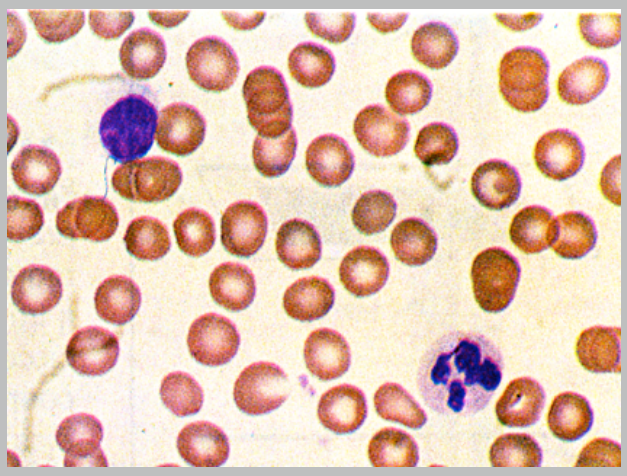

Nerve cells
Loose connective tissue with fibroblasts
Red blood cells
ssue
eocytes
Smooth
Fat (adipose) cells
Striated muscle cells
Intestinal epithelial cells

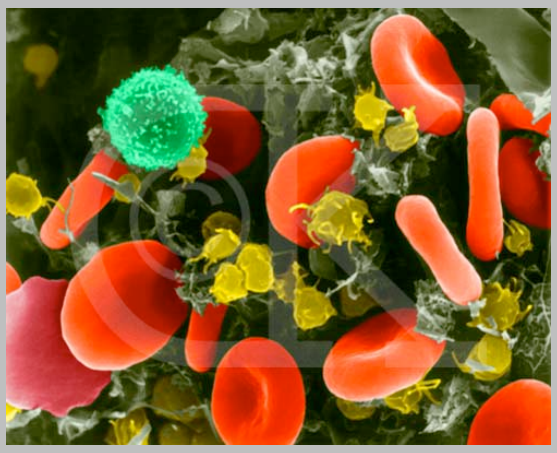
Cellule nervose



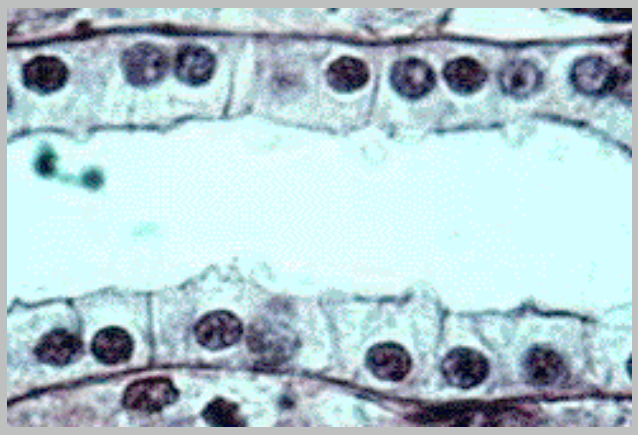


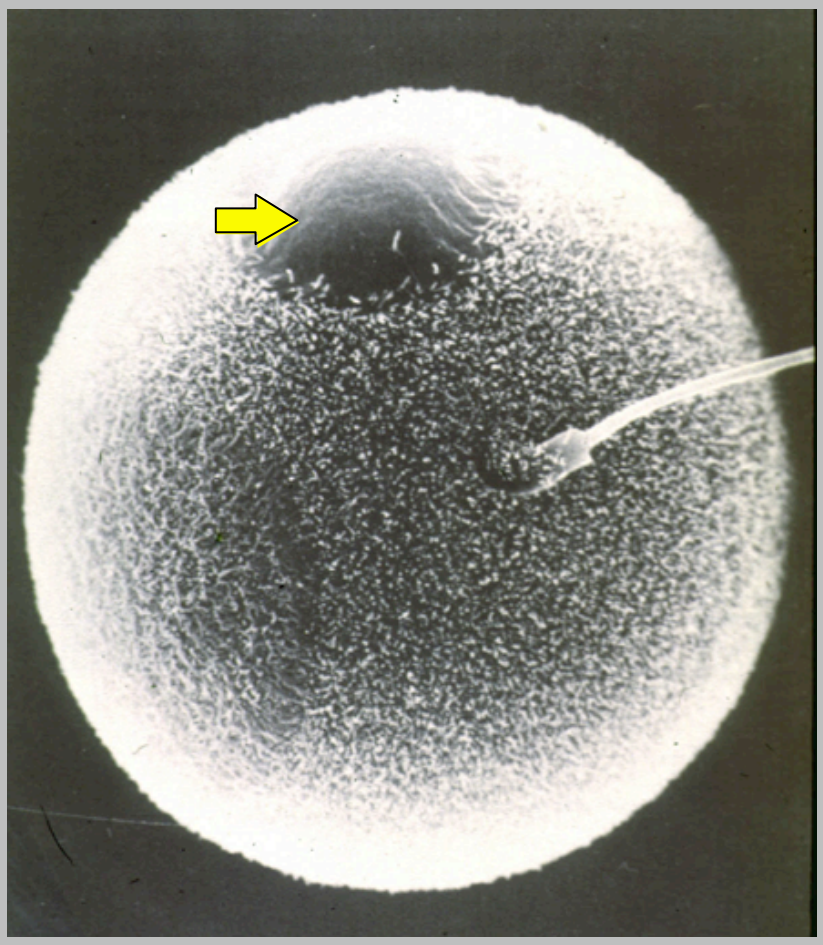
Cellule del sangue

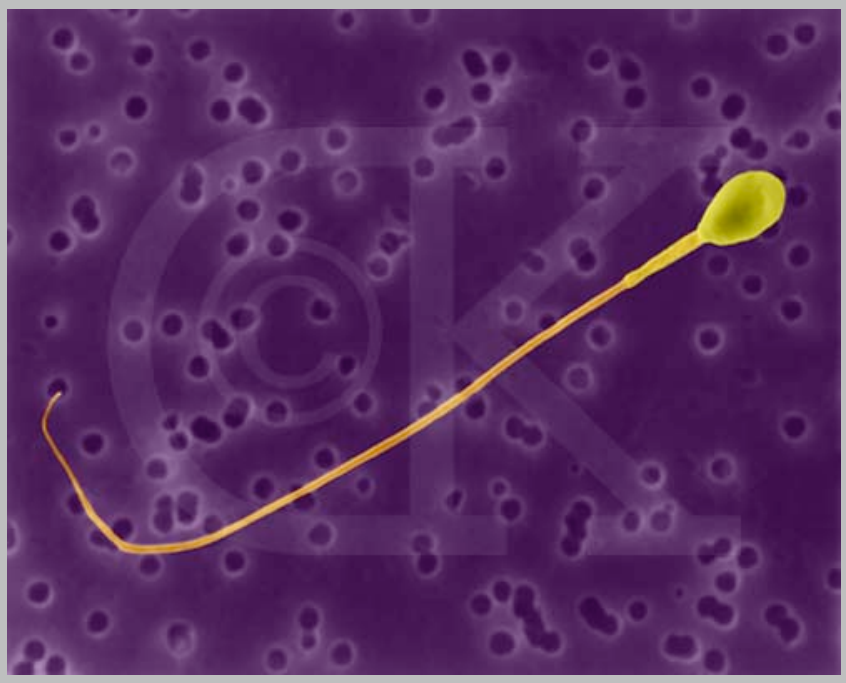


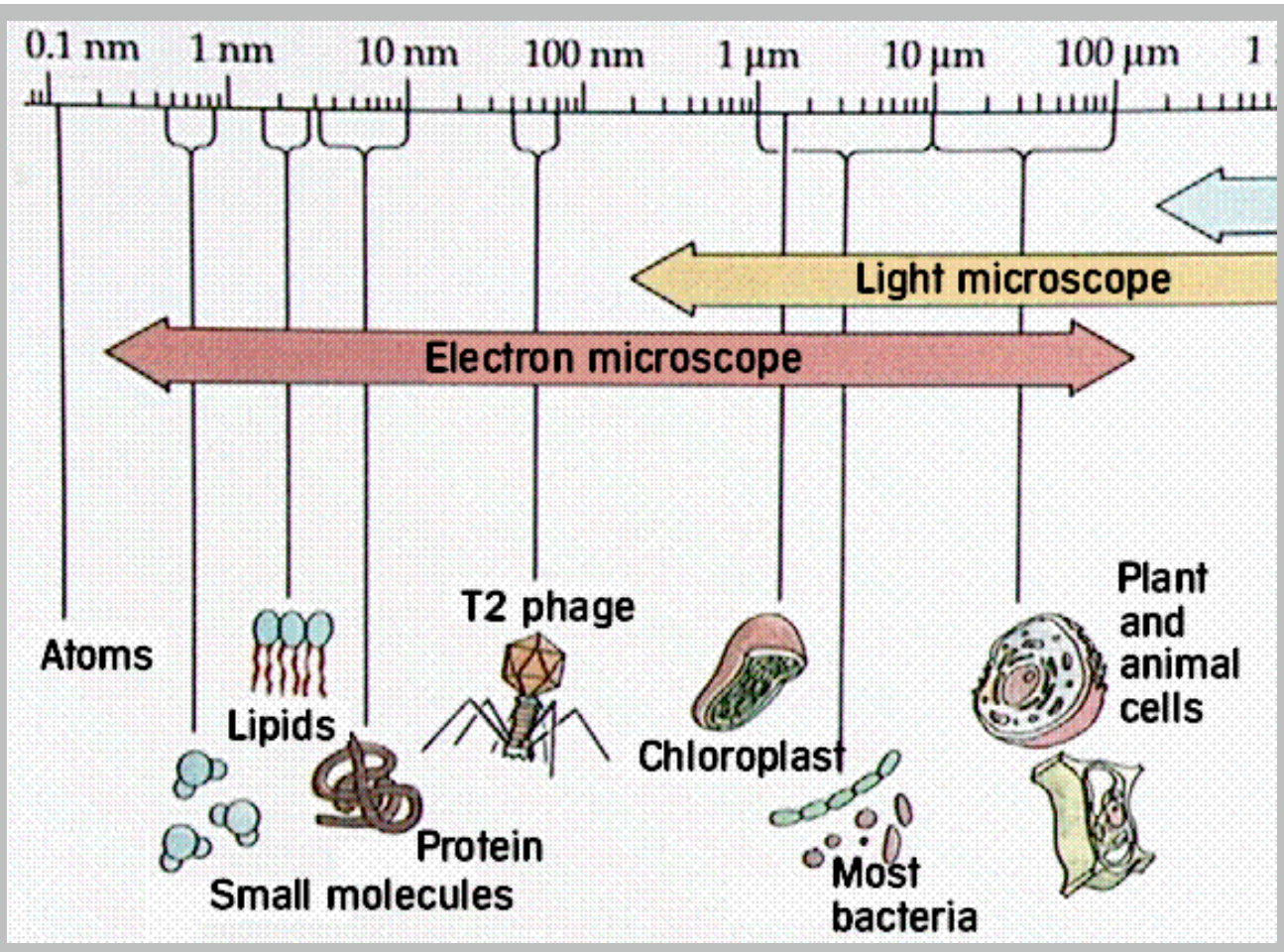


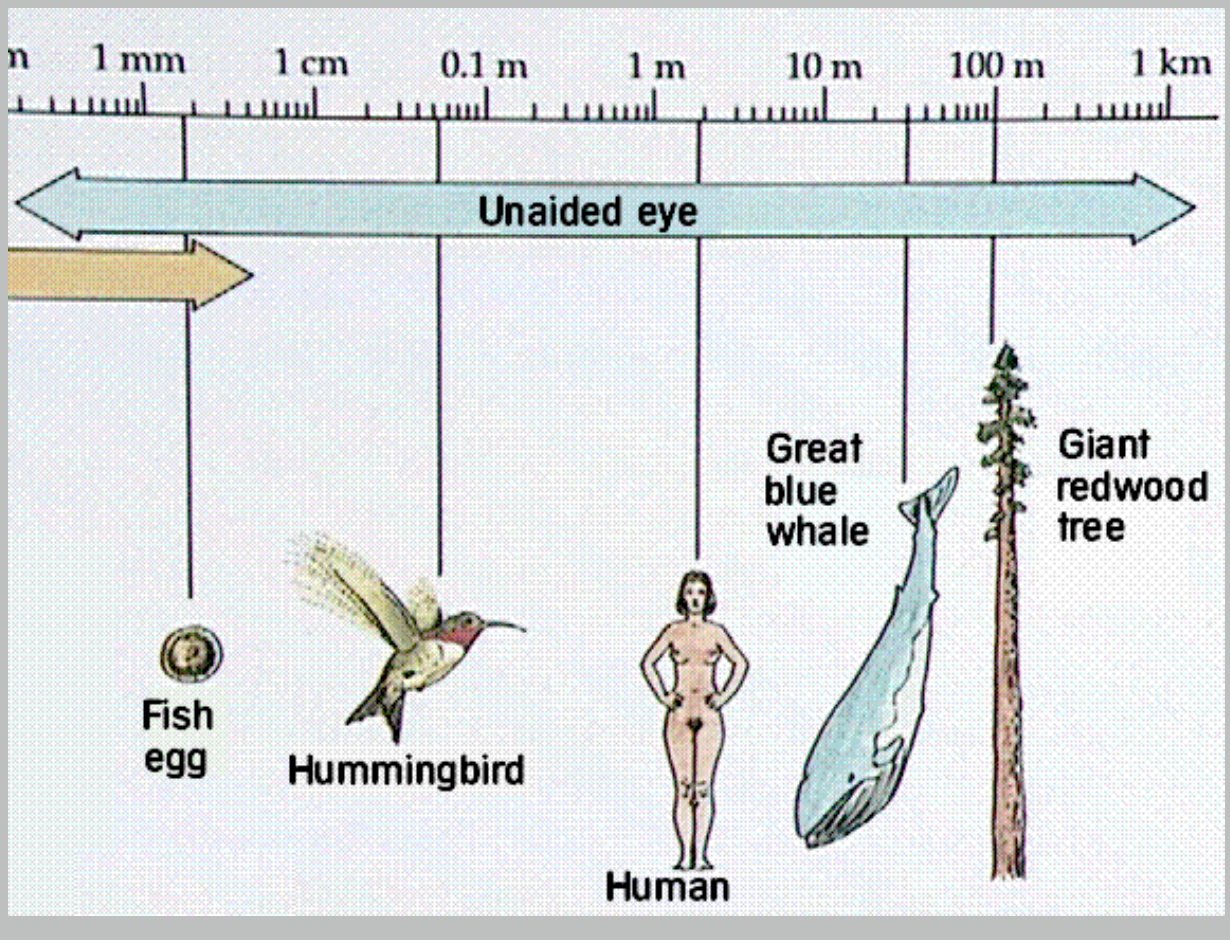
Cellule epiteliali

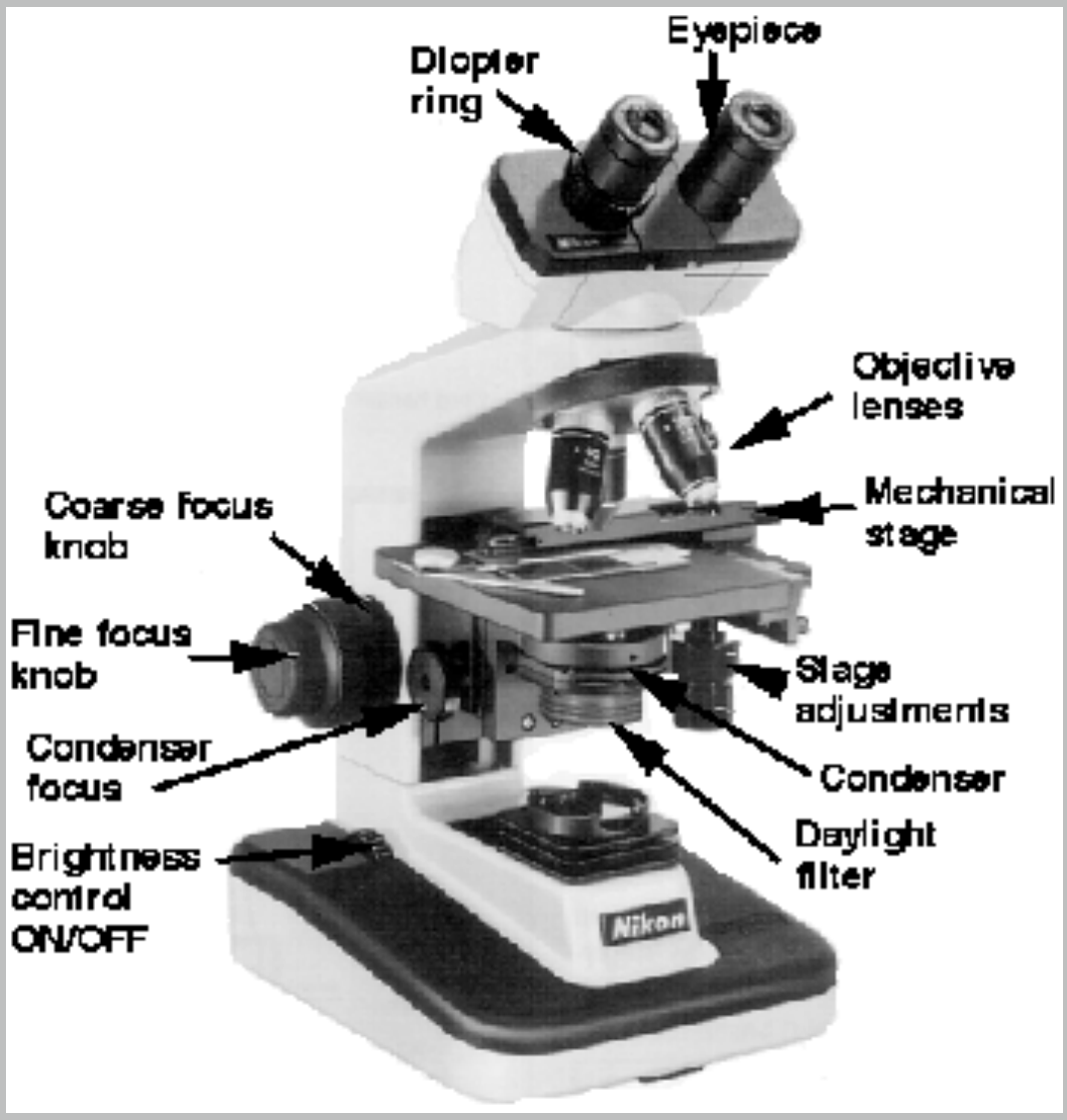







0.1 nm
1 nm
10 nm
100 nm
1 µm
10 µm
100 µm
1
Light microscope
Electron microscope
Atoms
Lipids
Small molecules
Protein
T2 phage
Chloroplast
Most bacteria
Plant and animal cells


n
1 mm
1 cm
0.1 m
1 m
10 m
100 m
1 km
Unaided eye
Fish egg
Hummingbird
Human
Great blue whale
Giant redwood tree



Light microscopes were the first to be developed, and still the most commonly used ones. The best **resolution** of light microscopes (LM) is **0.2 µm**. **Magnification** of LMs is generally limited by the **properties of the glass** used to make microscope lenses and the physical properties of their light sources. The generally accepted maximum magnifications in biological uses are between **1000X and 1250X**. Calculation of LM magnification is done by multiplying objective value by eyepiece value.

The microscope is an important tool used by biologists to magnify small objects. There are several concepts fundamental to microscopy.

Magnification is the ratio of enlargement (or eduction) between the specimen and its image (either printed photograph or the virtual image seen through the eyepiece).
To calculate magnification we multiply the power of each lens through which the light from the specimen passes, indicating that product as *GGGX*, where *GGG* is the product. For example: if the light passes through two lenses (an objective lens and an ocular lens) we multiply the 10X ocular value by the value of the objective lens (say it is 4X): 10 X 4=40, or 40X magnification.

Resolution is the ability to distinguish between two objects (or points). The closer the two objects are, the easier it is to distinguish recognize the distance between them. What microscopes do is to bring small objects "closer" to the observer by increasing the magnification of the sample. Since the sample is the same distance from the viewer, a "virtual image" is formed as the light (or electron beam) passes through the magnifying lenses. Objects such as a human hair appear smooth (and feel smooth) when viewed with the unaided or naked) eye. However, put a hair under a microscope and it takes on a VERY different look!

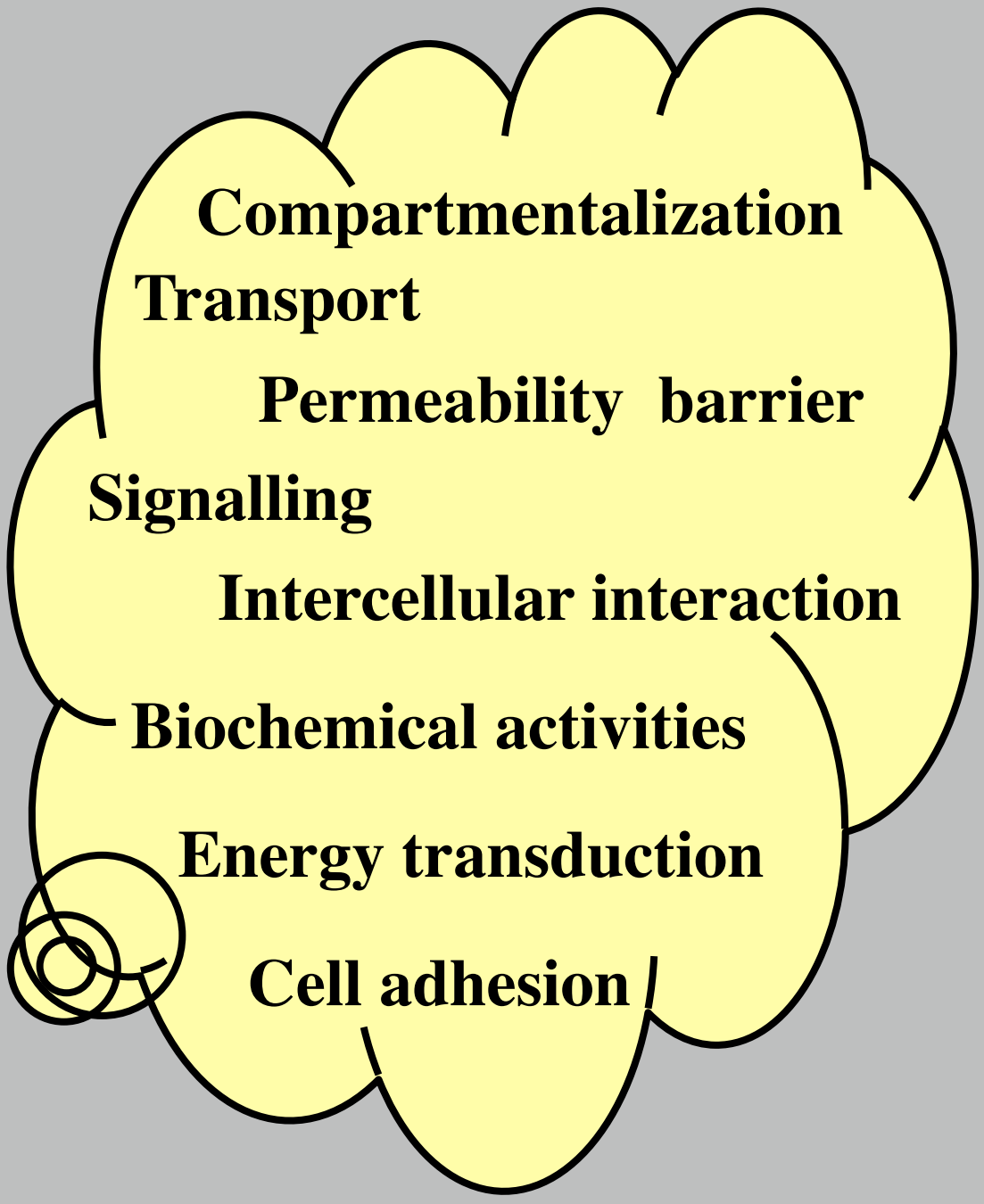
Working distance is the distance between the specimen and the magnifying lens.

Depth of field is a measure of the amount of a specimen that can be in focus.

Instead of using light as an imaging source, a high energy beam of electrons (between 5 thousand and 1 billion electron volts) is focused through electromagnetic lenses (instead of glass in LM). The increased resolution results from the shorter wavelength of the electron beam, increasing resolution in the transmission electron microscope (TEM) to a theoretical limit of 0.2 nm. The magnifications reached by TEMs are commonly over 100,000X, depending on the nature of the sample and the operating condition of the TEM. The other type of electron microscope is the scanning electron microscope (SEM). It uses a different method of electron capture and displays images on high resolution television monitors. The resolution and magnification of the SEM are less than that of the TEM although still orders of magnitude above the LM.

LE MEMBRANE

Funzioni delle membrane biologiche



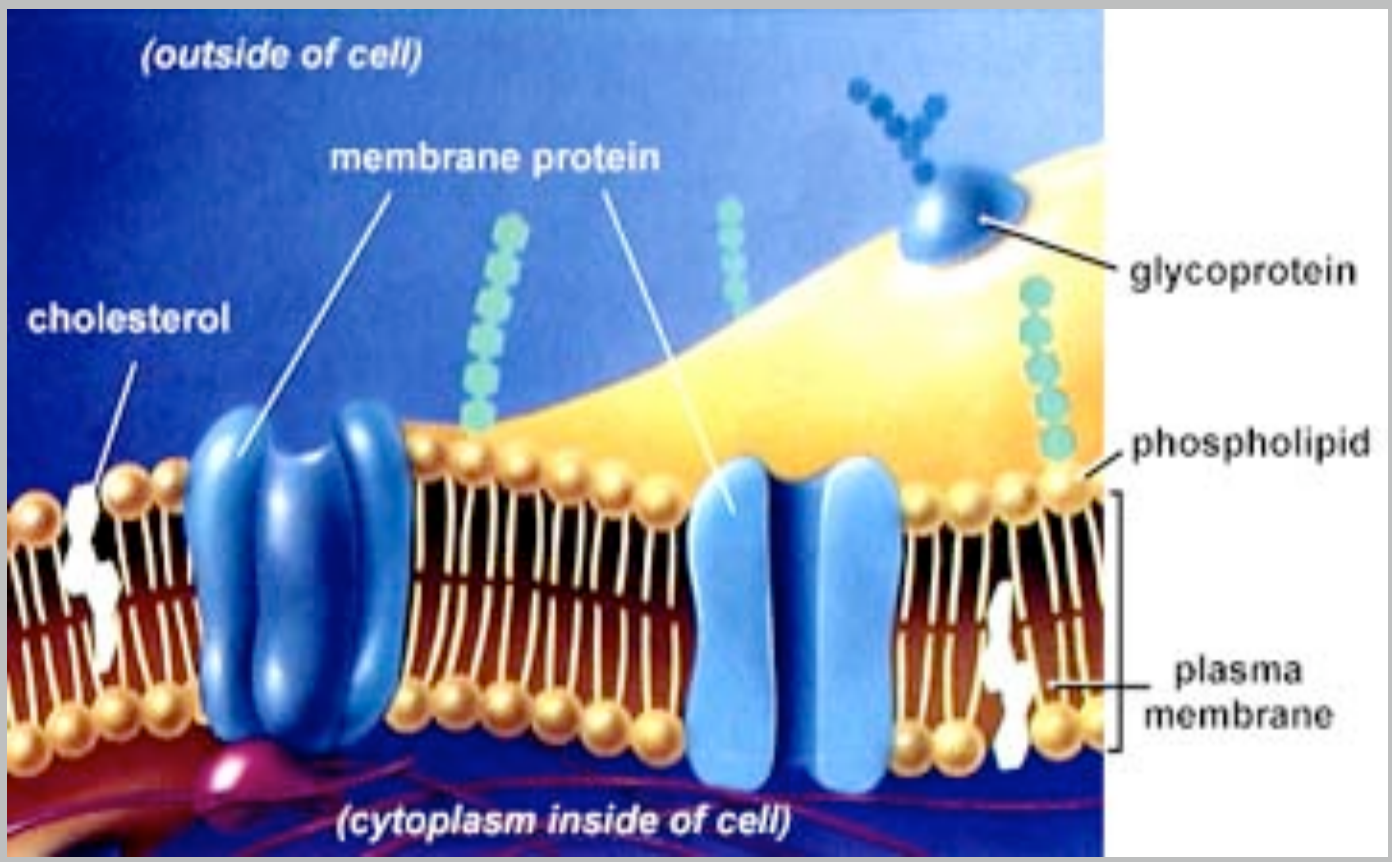
Struttura

- Modello a mosaico fluido
- Doppio strato fosfo-lipidico
- Il doppio strato e' fluido con all'interno proteine fluttuanti

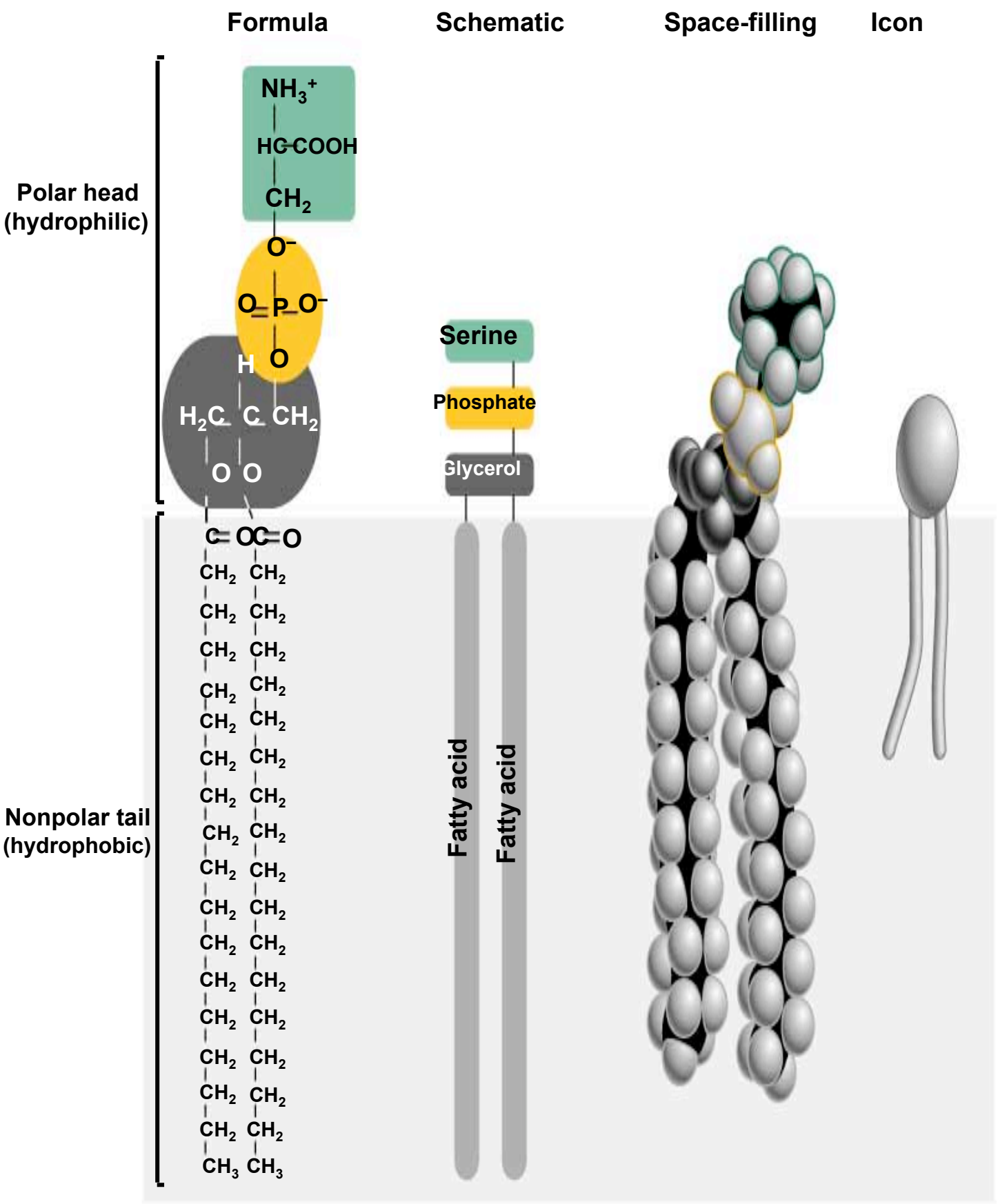
Composition

All membranes are lipid-protein assemblies in which the components are hold together in a thin sheet by non-covalent bonds

- **Lipids**
  - **Phosphoglycerides**
  - **Sphingolipids**
  - **Cholesterol**
- **Proteins**
- **Carbohydrates**
  - **glycolipids**
  - **glycoproteins**



Phospholipids



Lipid micelles

Water

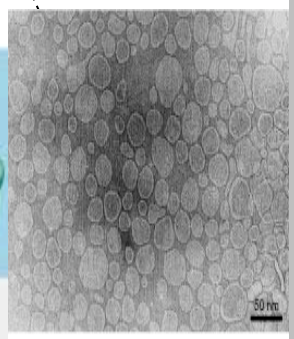
No water

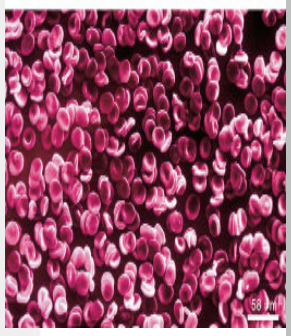
Lipid bilayers

Serine

Phosphate

Hydrophilic heads interact with water





Hydrophobic tails interact with each other

Hydrophilic heads interact with water

Membranes are fluid

Membrane fluidity

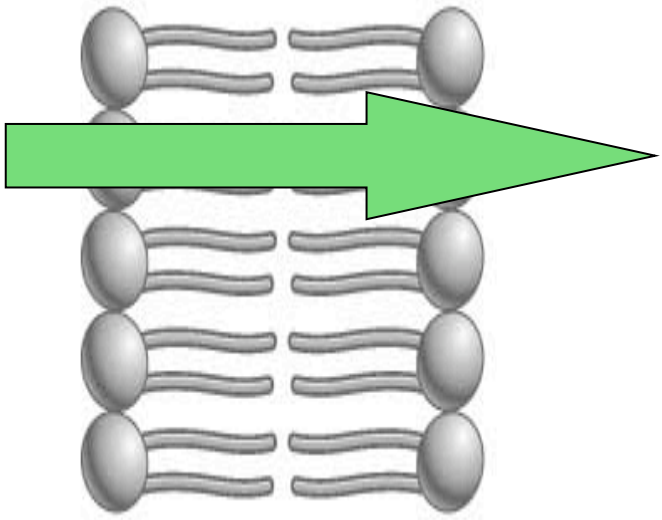
Movement of Substances Across Membranes

- **Diffusion**
  - **Diffusion is a spontaneous, passive process.**
    - Molecules and ions move downhill along electrochemical gradients
    - Facilitated diffusion: assisted by a type of membrane protein called an ionophore

- **Osmosis**
  - **Diffusion of water across a membrane towards regions of higher solute concentration**

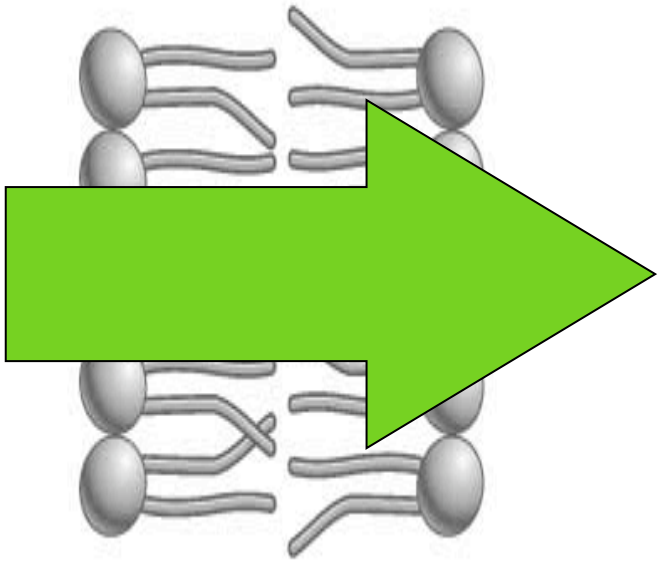
Kinks change the permeability of membranes.

Lipid bilayer with no unsaturated fatty acids



Low permeability

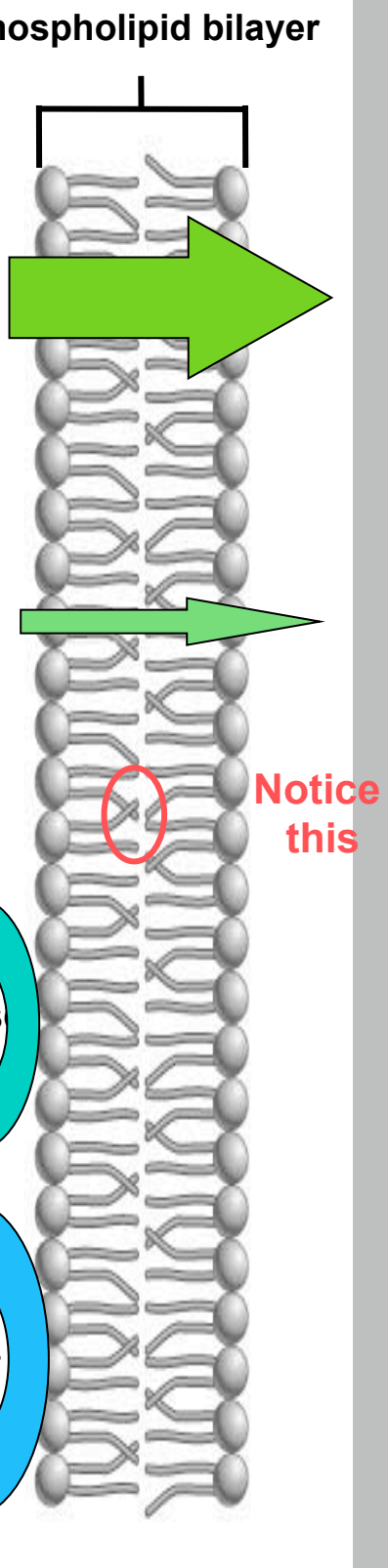
Lipid bilayer with many unsaturated fatty acids



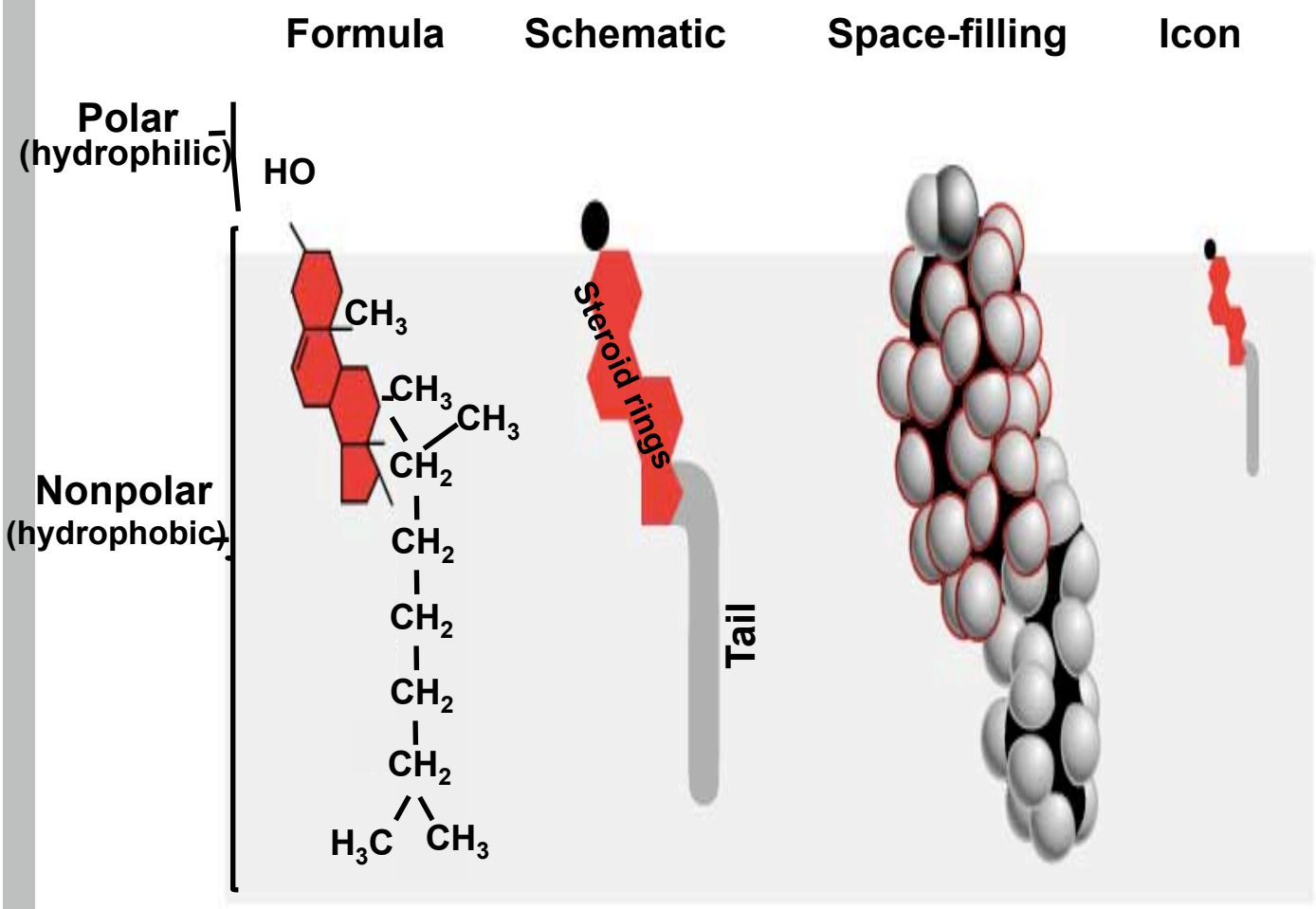
High permeability

Summary of relative permeabilities

Hydrophobic molecules	O_2, CO_2, N_2
Small, uncharged polar molecules	H_2O, glycerol
Large, uncharged polar molecules	Glucose, sucros
Ions	H^+,Na^+,NCO_3^-, Ca^{2+},CL^-,Mg^{2+},K^+

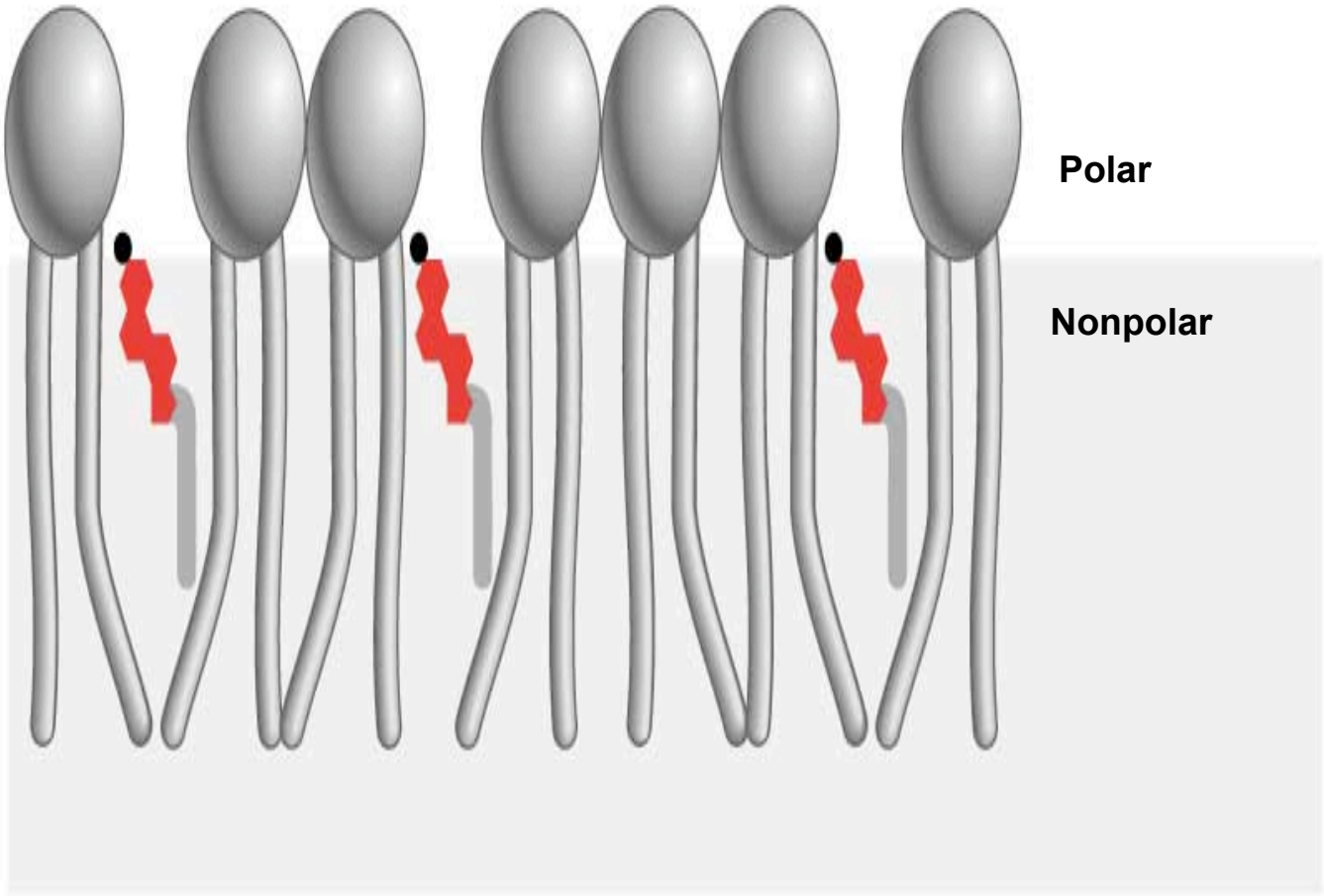


Cholesterol



Cholesterol fills spaces between phospholipids allows

- **closer packing**
- **decreases fluidity**



Membrane Proteins

- Types of proteins in a membrane can vary
- There can be 50 different types of membrane proteins in a single type of cell
- One type can occur in up to 100,000 copies

Membrane Proteins

Three types:

- Peripheral proteins (noncovalent bonds)

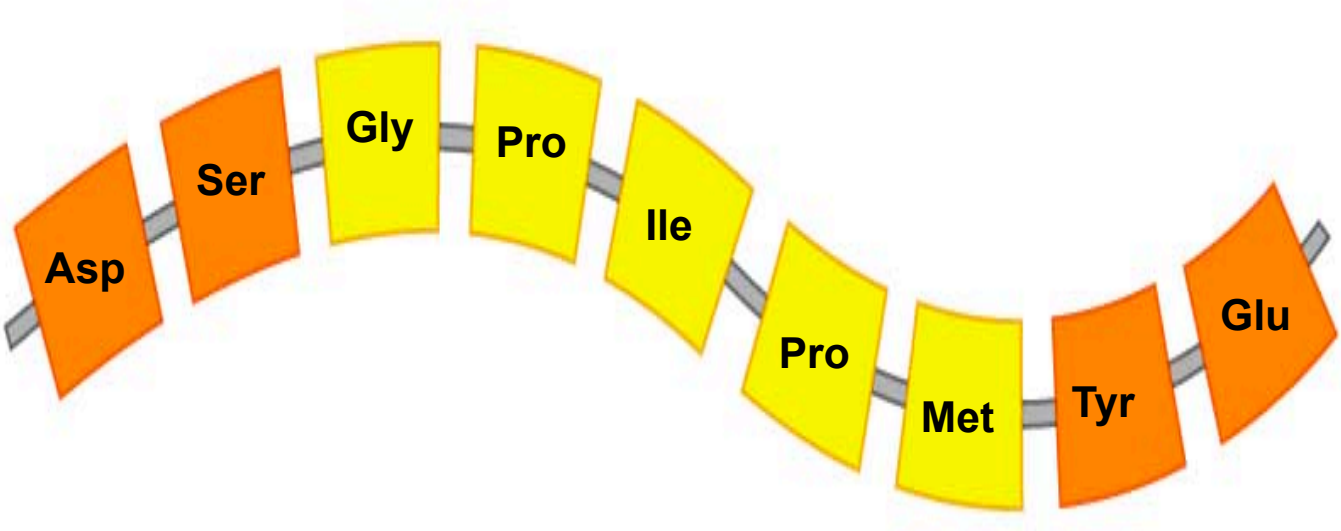
- Integral proteins that penetrate into the lipid bilayer (transmembrane proteins)

- Lipid-anchored proteins

Movement across membranes is affected by the presence of proteins.

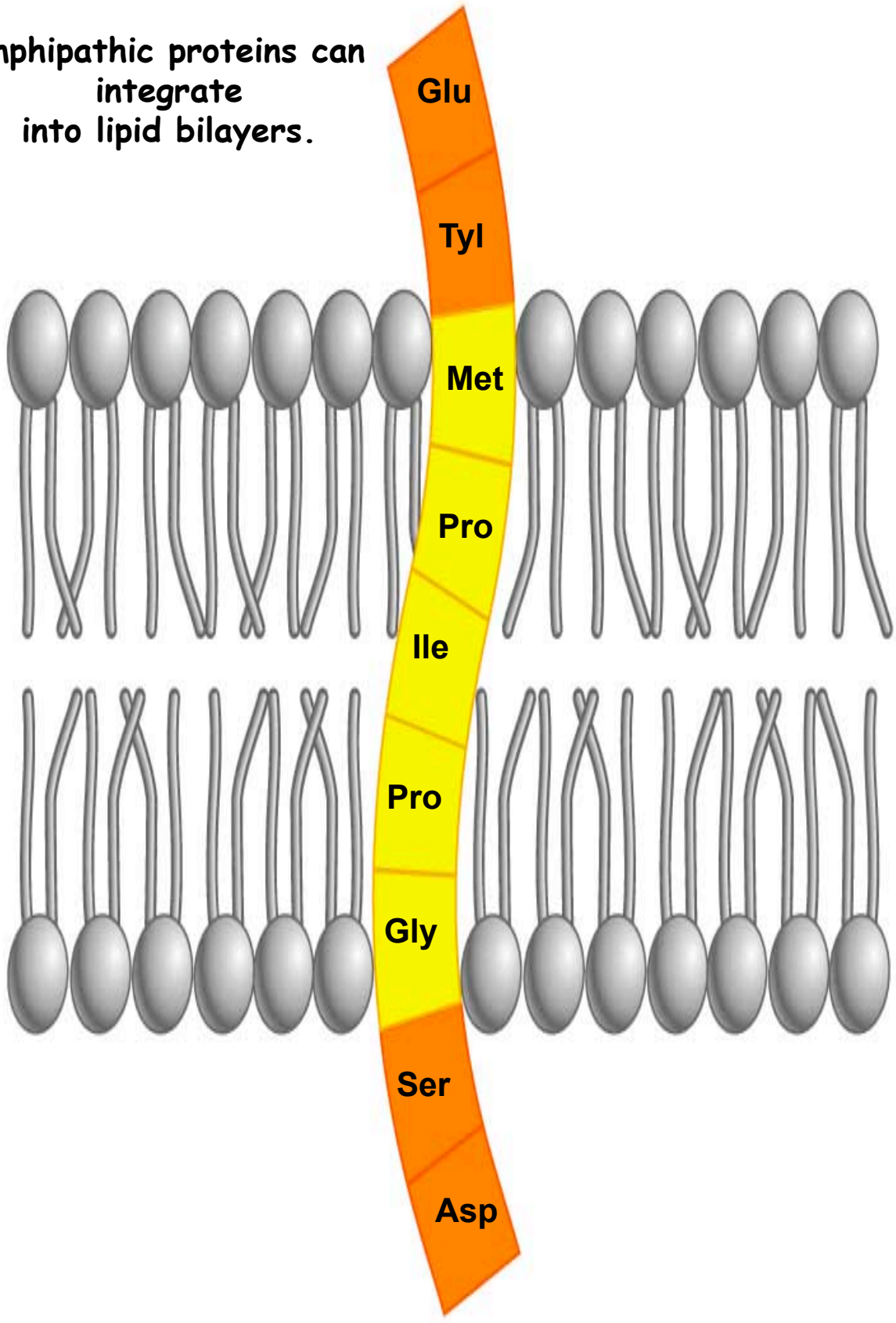
Membrane-associated proteins can be amphipathic (dual sympathy)

Proteins can be amphipathic.

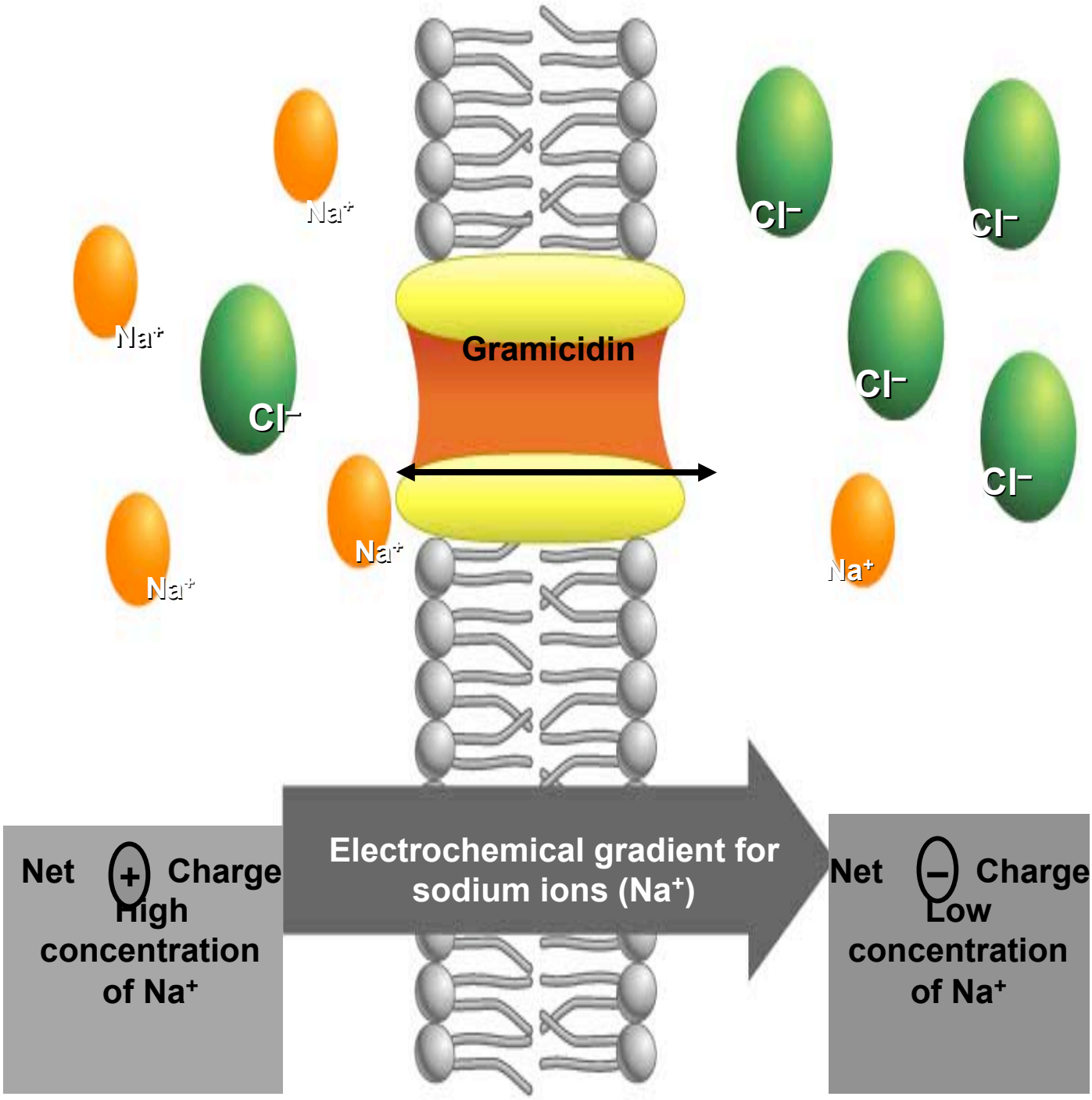


Integral membrane proteins

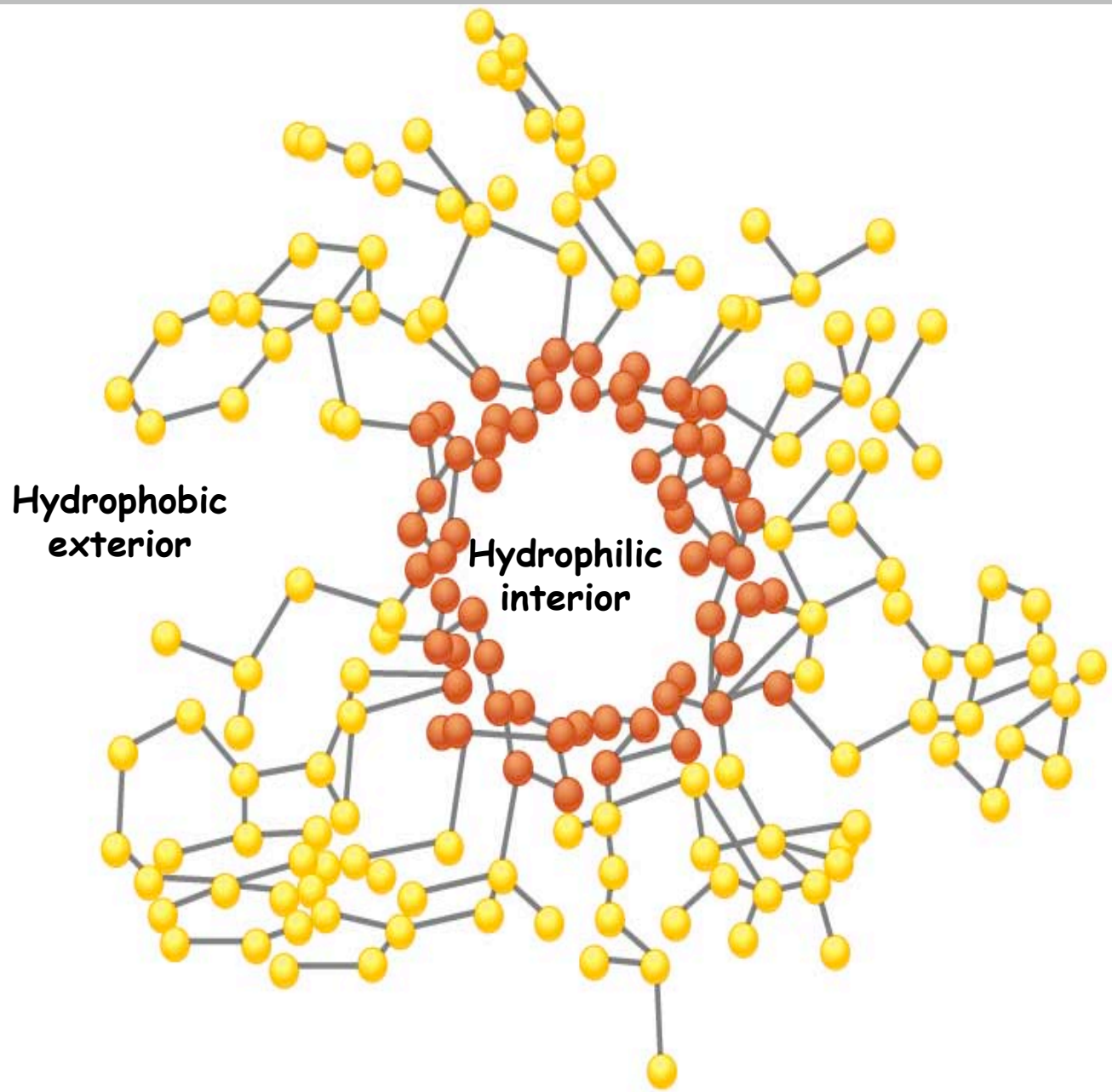
Amphipathic proteins can integrate into lipid bilayers.



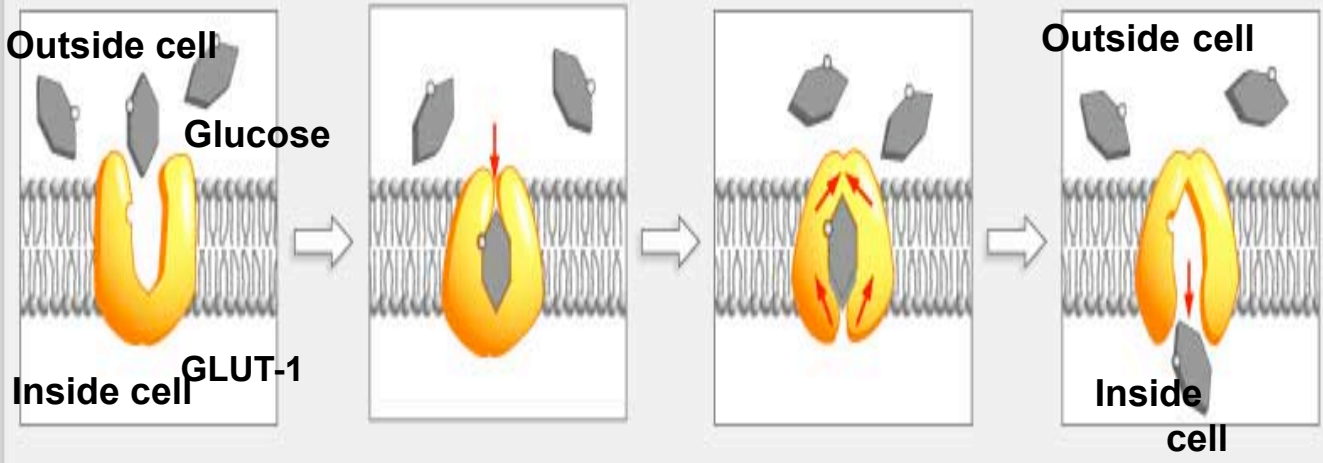
Imbedded proteins have many functions: receptors, transport, connections between cells Electrochemical gradients across membranes Experiments with protein ionophores, which facilitate the diffusion of ions: Gramicidin forms a channel in the membrane through which cations move: toxic if taken internally but used topically as an Antibiotic.



Gramicidin is an ion channel



HOW GLUT-1 FACILITATES GLUCOSE DIFFUSION



1. GLUT-1 is a membrane protein, shown with its binding site facing outside the cell.

2. Glucose binds to GLUT-1 from outside the cell.

3. A conformational change results, transporting glucose to the interior.

4. Glucose is released inside of cell.

The Nobel Prize in Chemistry 2003

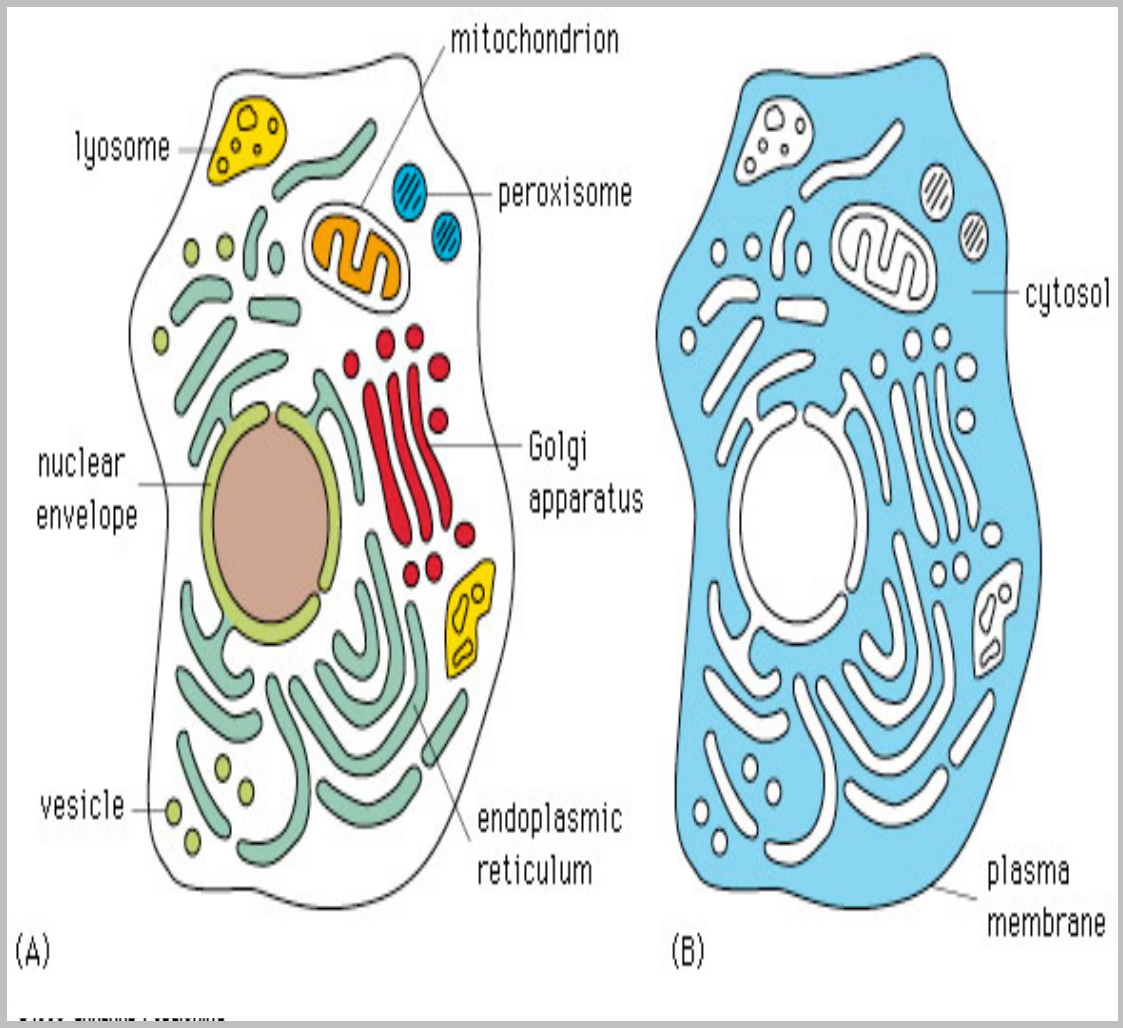
"for the discovery of water channels"

"for discoveries concerning channels in cell membranes"

Peter Agre
Johns Hopkins University
School of Medicine
Baltimore, MD, USA
(born 1949)

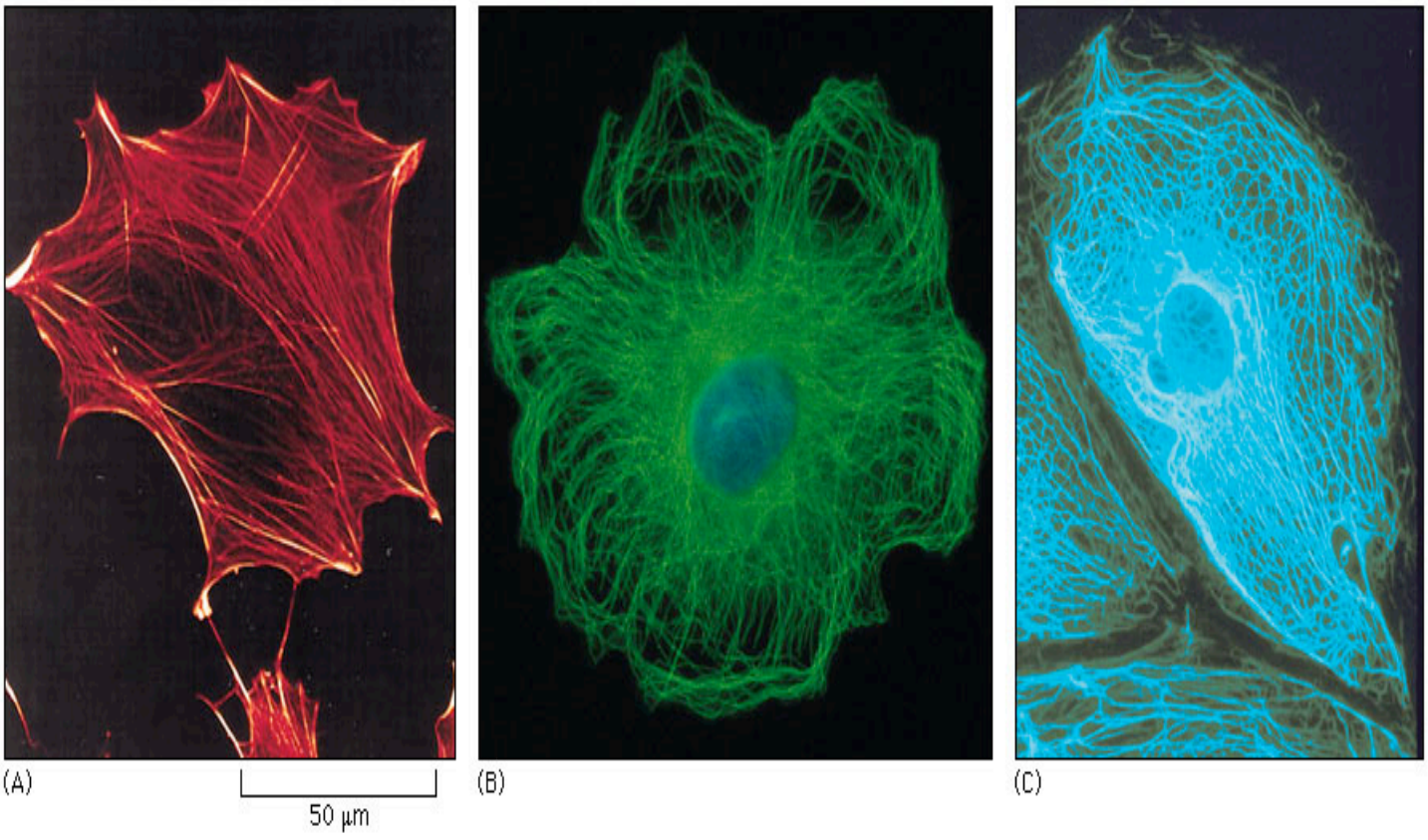
Roderick MacKinnon
Rockefeller University,
Howard Hughes Medical
Institute, New York, NY,
USA (born 1956)

Cytosol

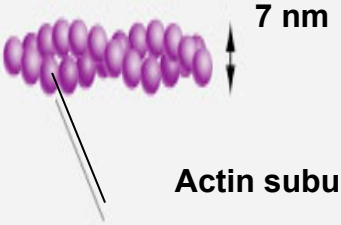
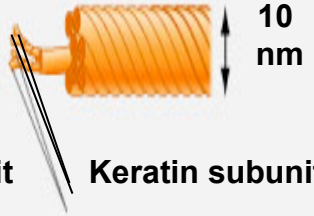
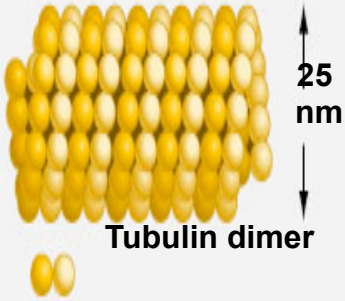

mitochondrion
lysosome
peroxisome
nuclear envelope
Golgi apparatus
vesicle
endoplasmic reticulum
(A)
cytosol
plasma membrane
(B)

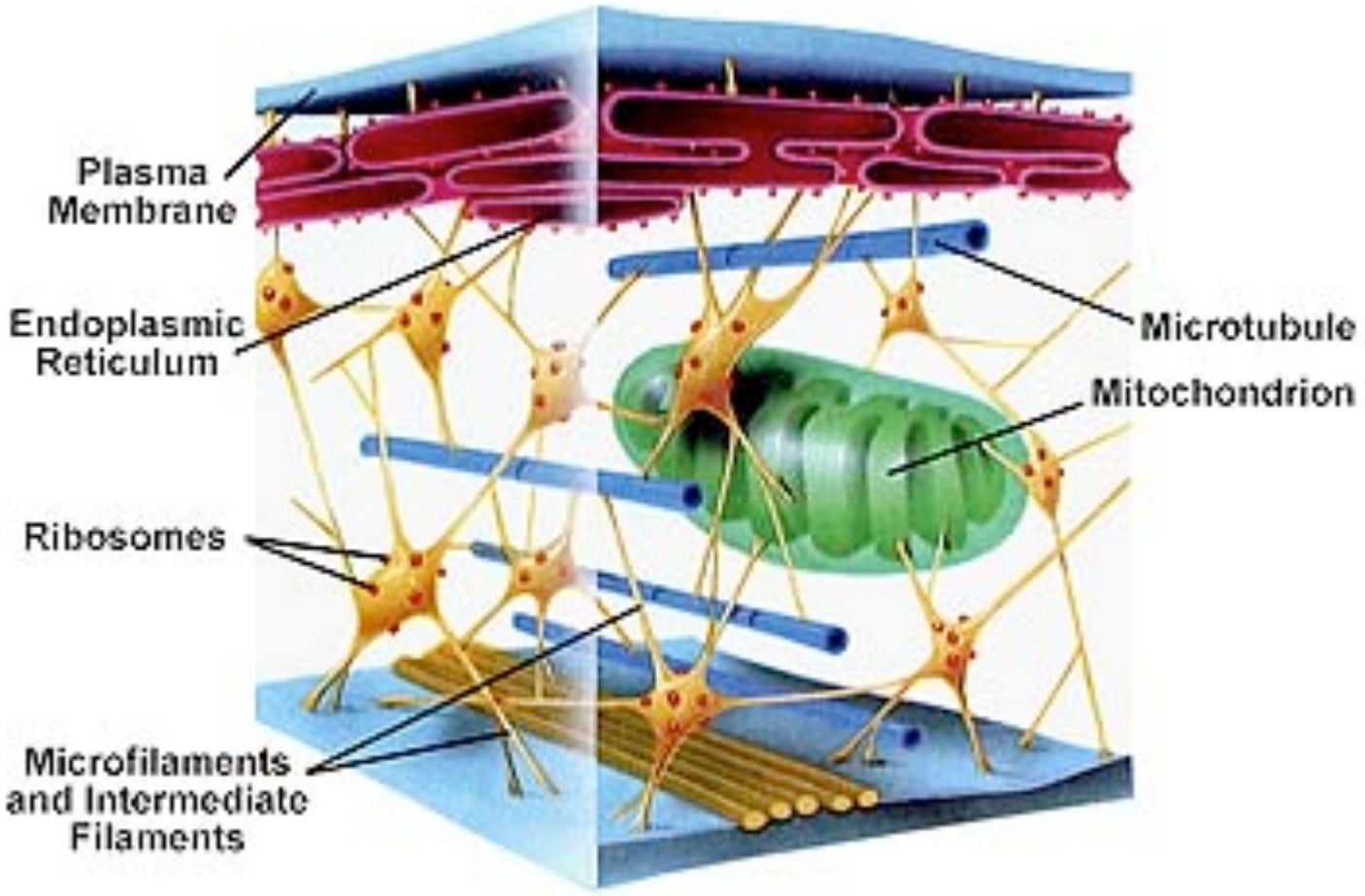
Cytoskeleton

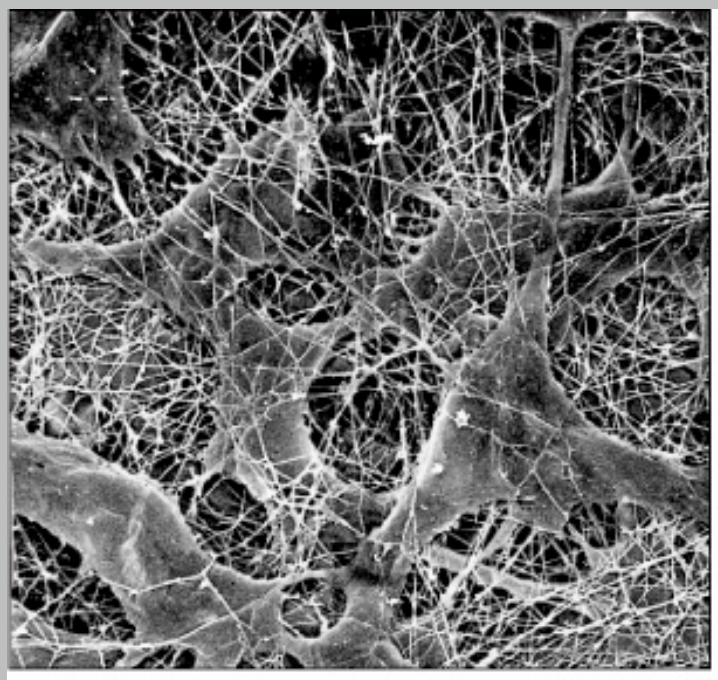
is the infrastructure on which most intracellular transport occurs

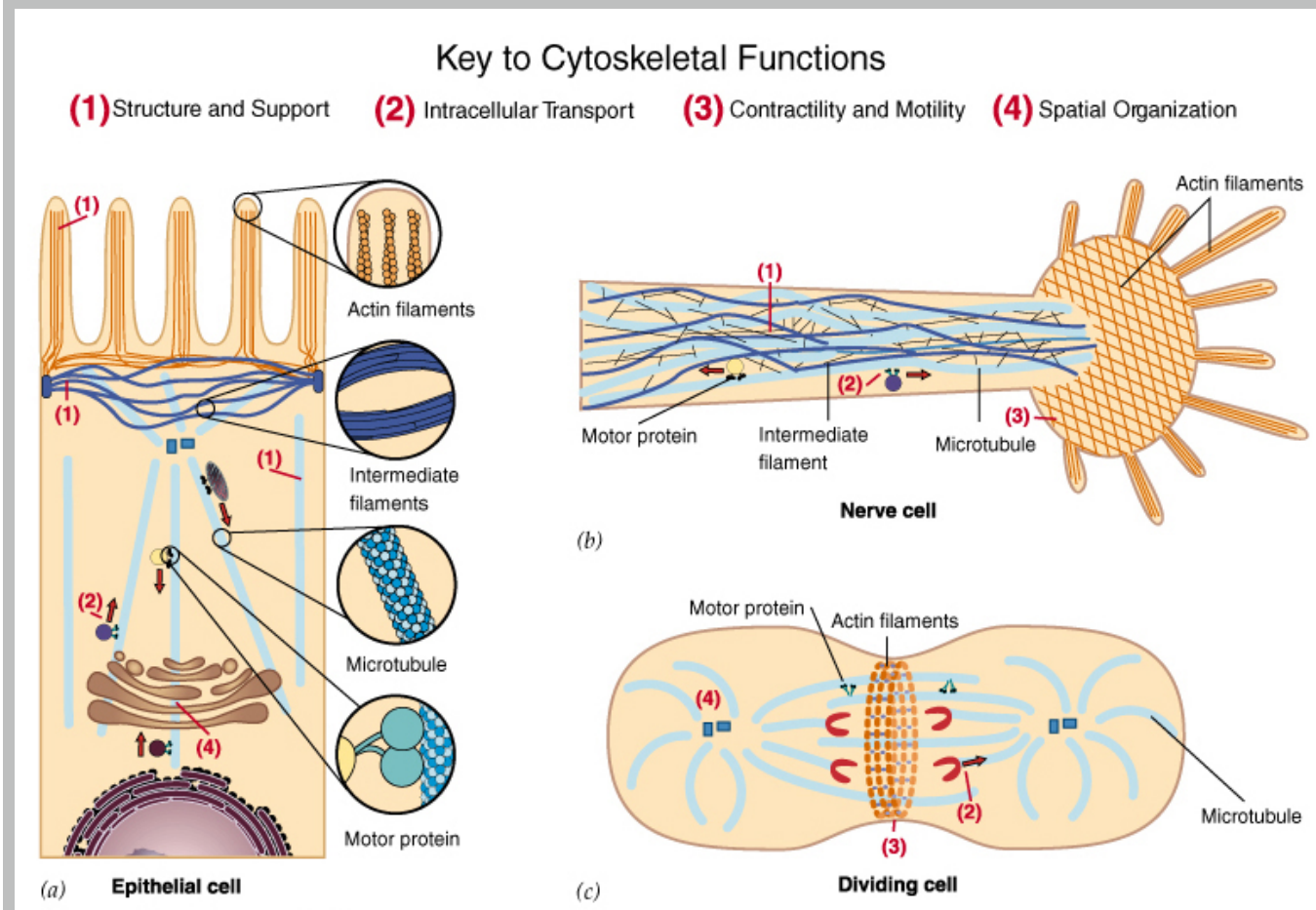


microfilaments microtubules Intermediate filaments

	Microfilaments	Intermediate filaments	Microtubules
Protein subunits	Actin	Keratin, vimentin, lamin, others	α-tubulin and β-tubulin dimers
Structure	Two intertwined strands	Fibers wound into thicker cables	Hollow tube
	 Actin subunit	 Keratin subunits	 Tubulin dimer
Functions	• maintain cell shape by resisting tension (pull) • motility via pseudopodia • muscle contraction • cell division in animals	• maintain cell shape by resisting tension (pull) • anchor nucleus and some other organelles	• maintain cell shape by resisting compression (push) • motility via flagella or cilia • move chromosomes during cell division • move organelles


Plasma Membrane
Endoplasmic Reticulum
Ribosomes
Microfilaments and Intermediate Filaments
Microtubule
Mitochondrion


0.1 µm



Internal cell movement

Grazie ai motori molecolari che lavorano in associazione con il citoscheletro

Tre famiglie:

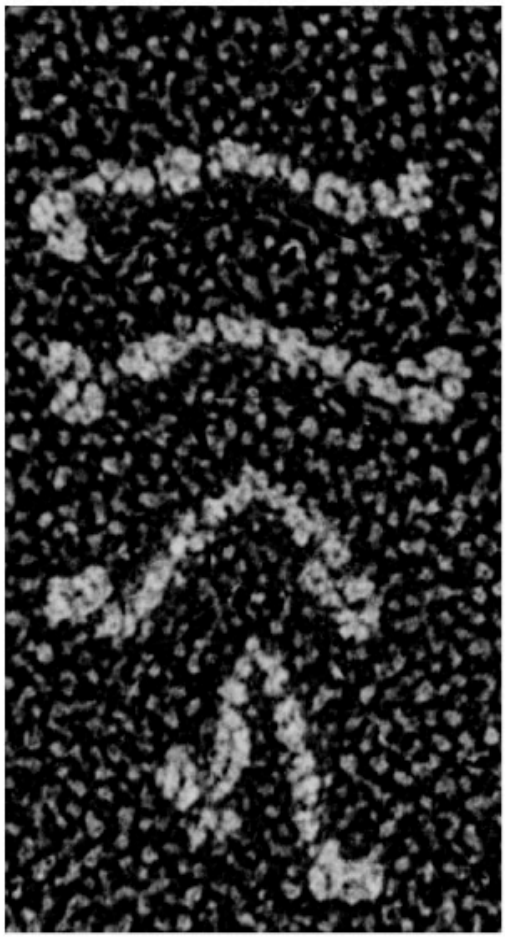
Miosine (si muovono lungo i microfilamenti)

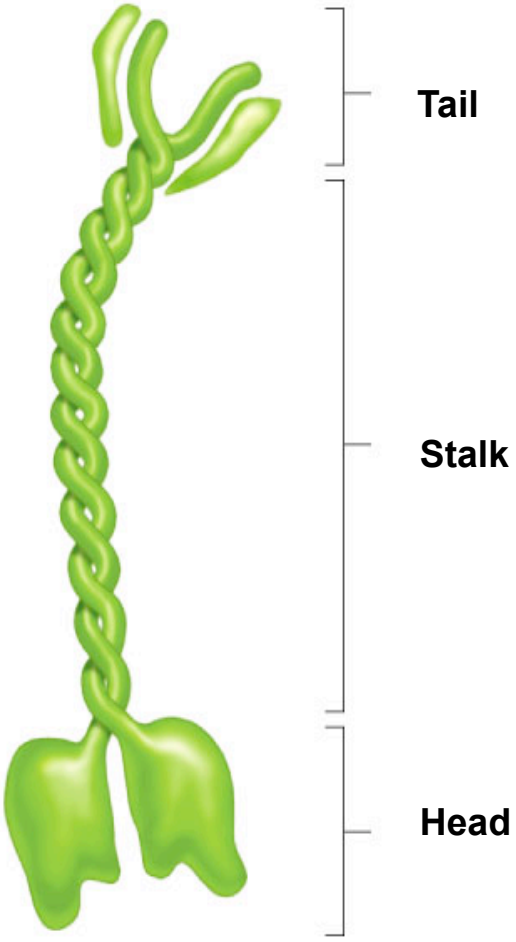
Chinesine (si muovono lungo i microtubuli)

Dineine (si muovono lungo i microtubuli)

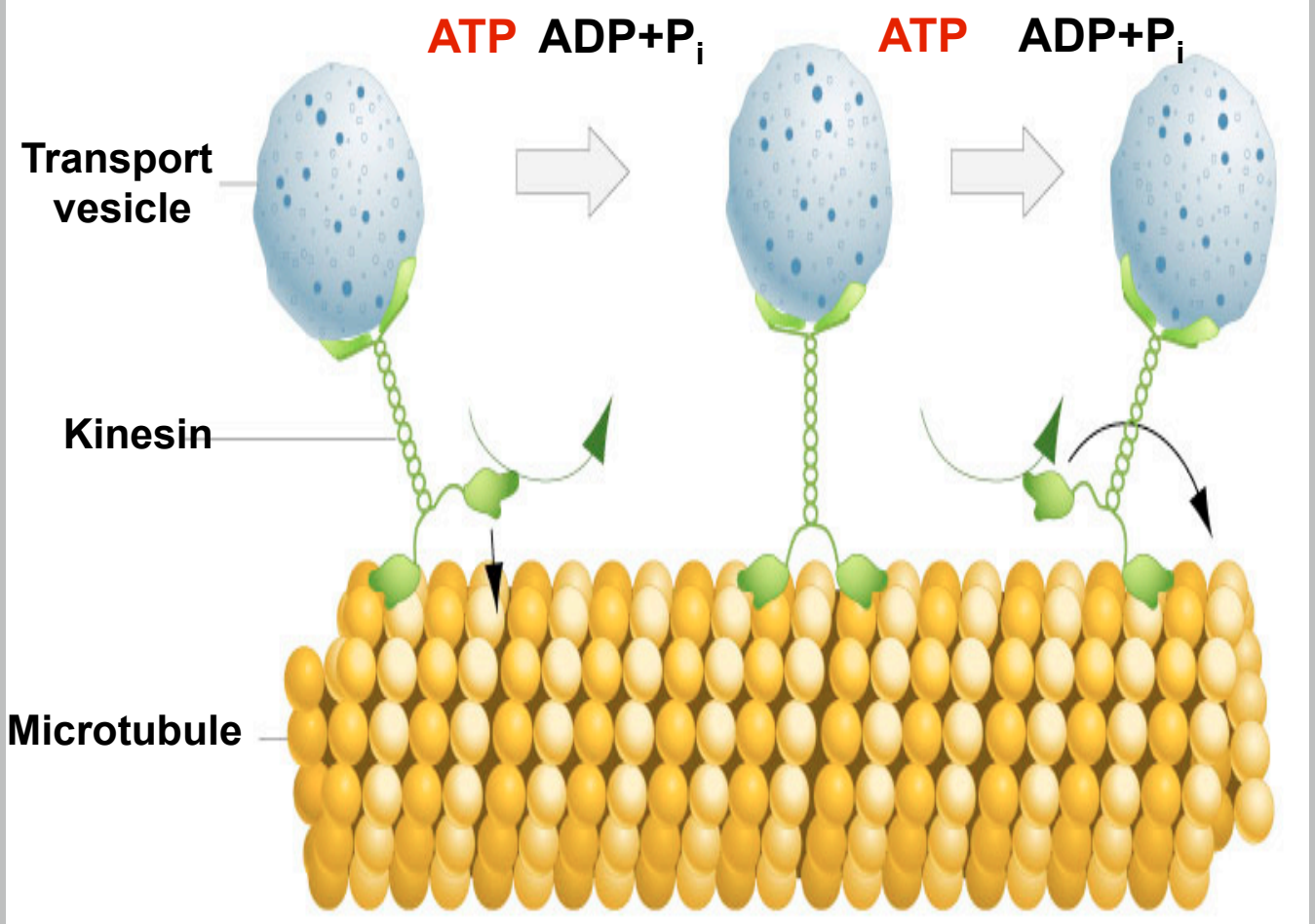
Le proteine motore trasformano l'energia chimica (ATP) in energia meccanica per muovere carichi cellulari (vescicole, mitocondri, lisosomi, cromosomi etc..)

Structure of kinesin: one mechanism of movement





Kinesin "walks" along a microtubule track



Where does the chemical energy used to power cell activities come from?