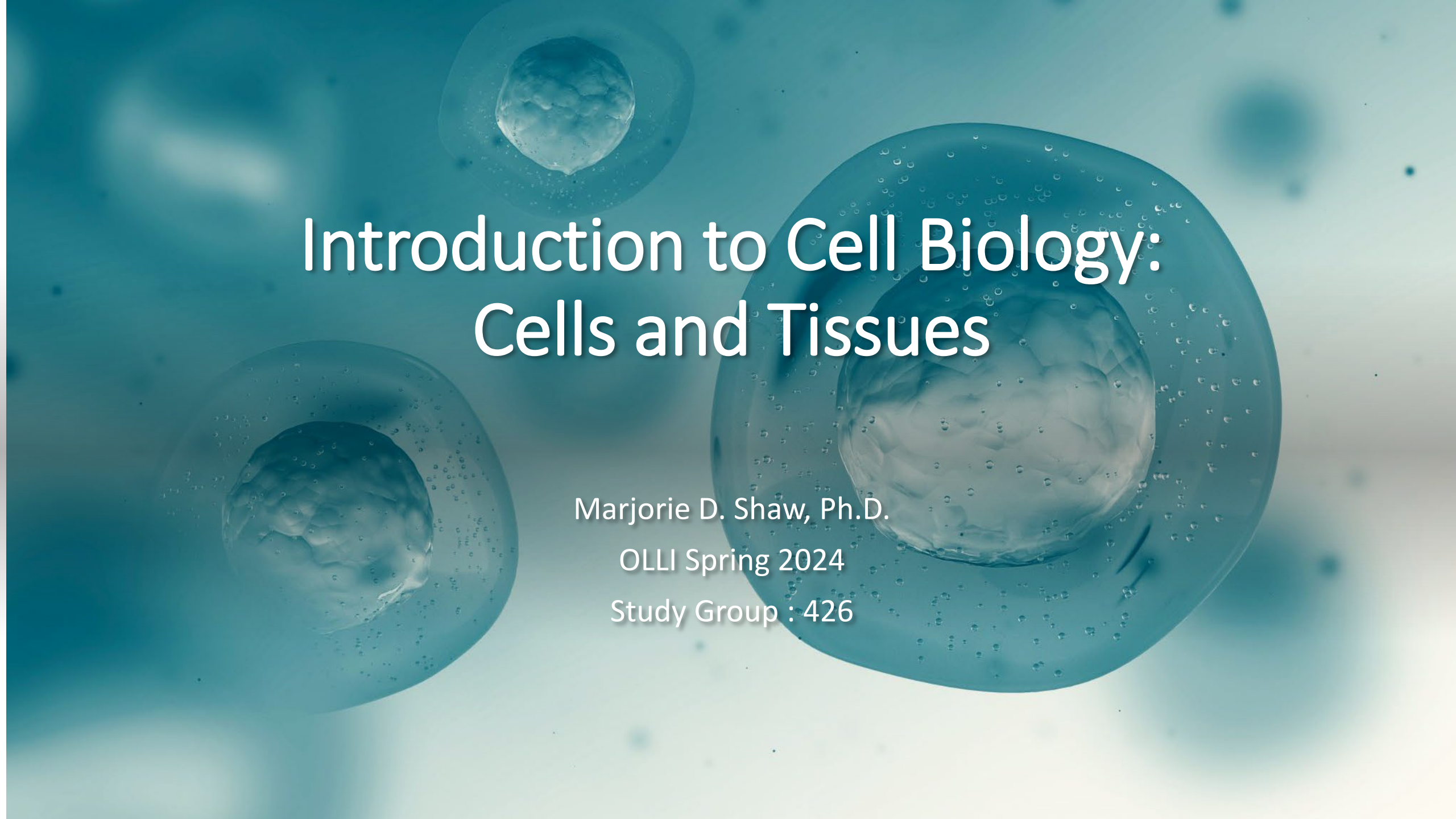

Introduction to Cell Biology: Cells and Tissues

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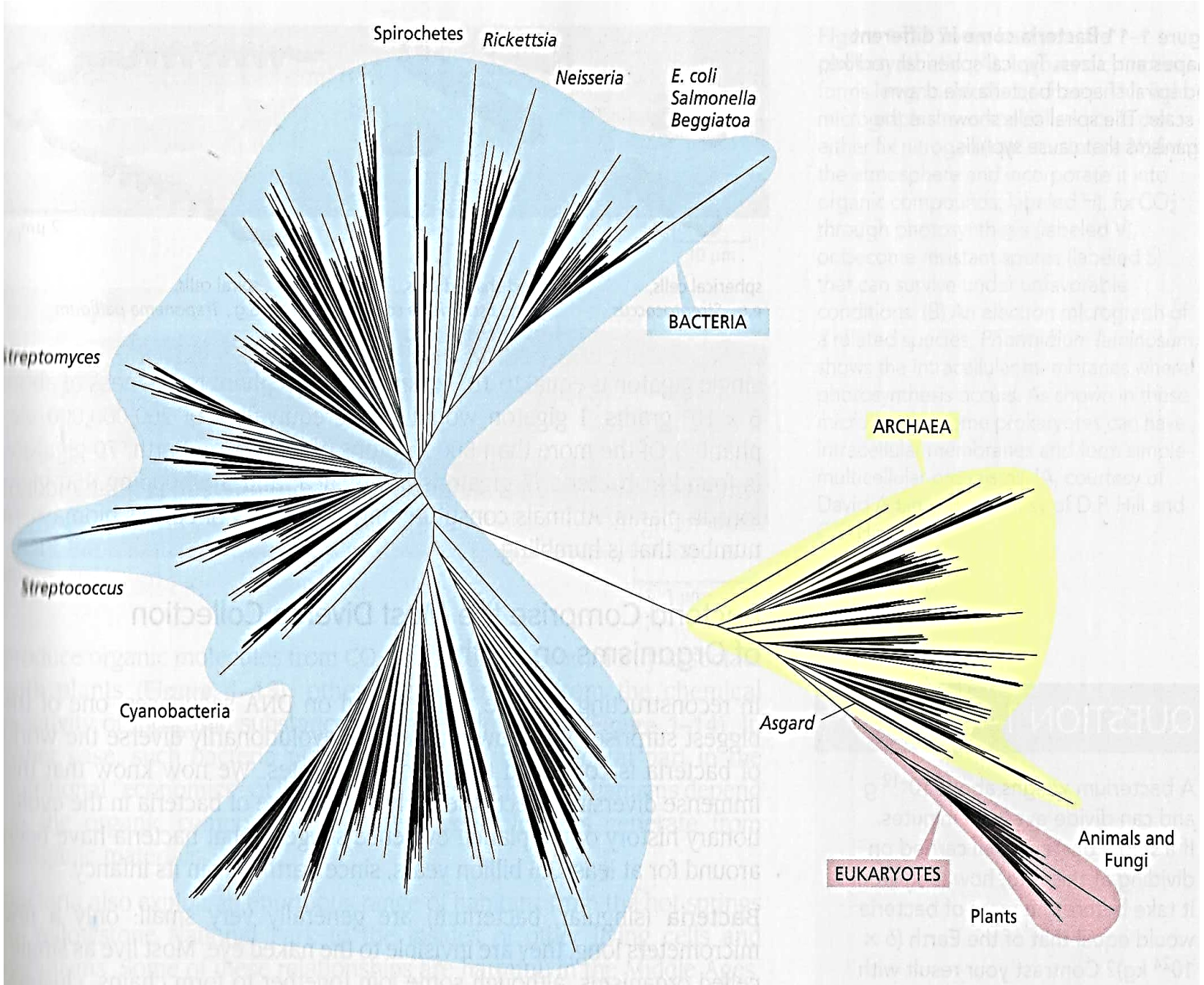
OLLI Spring 2024

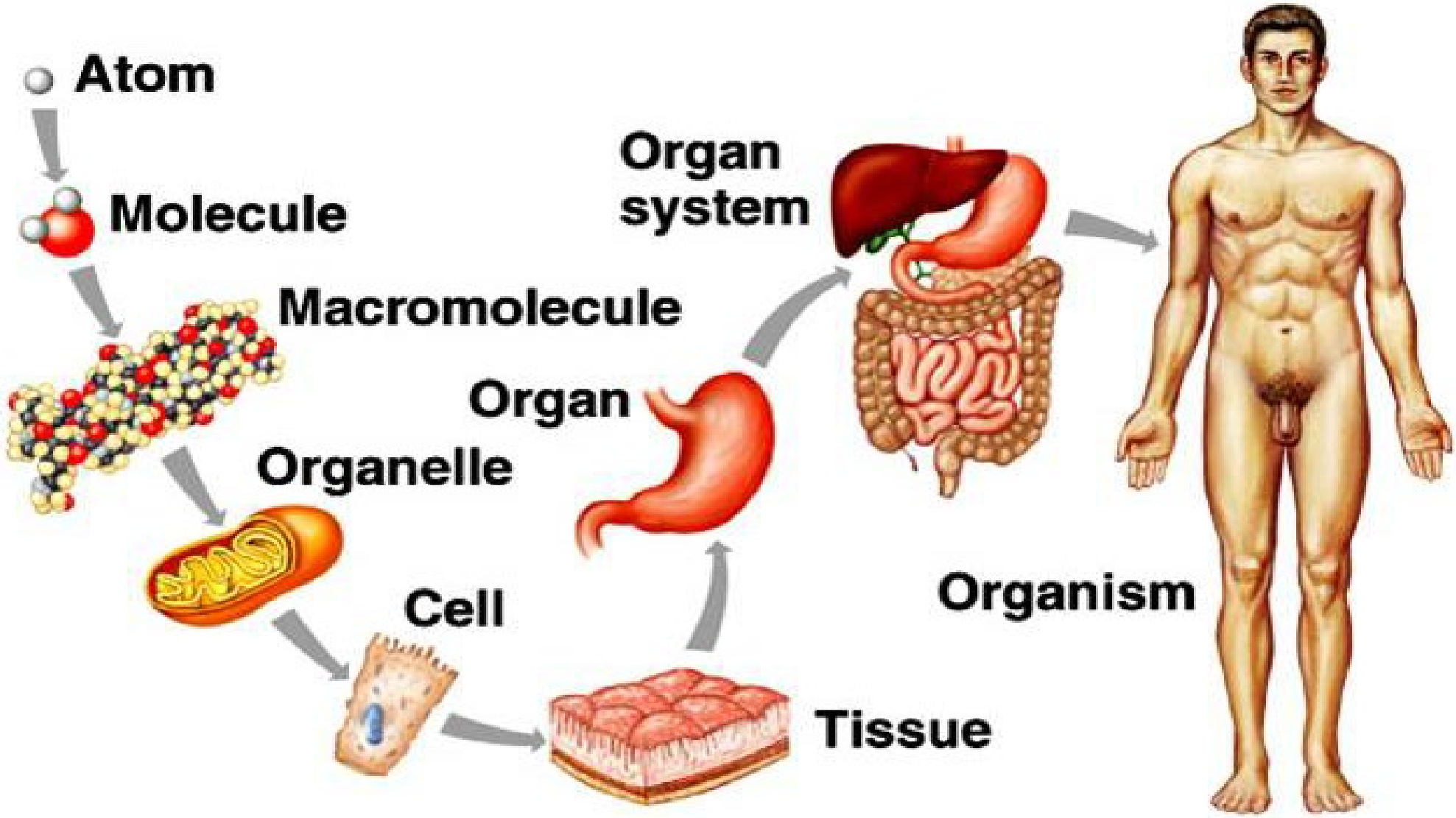
Study Group : 426

Cell = Basic Unit of Life

All living things are built from cells, whether bacteria, archea or eucaryotes. *Eucaryotes* are cells with nuclei: fungi, plants and animals. We are going to be describing animal cells, especially human.

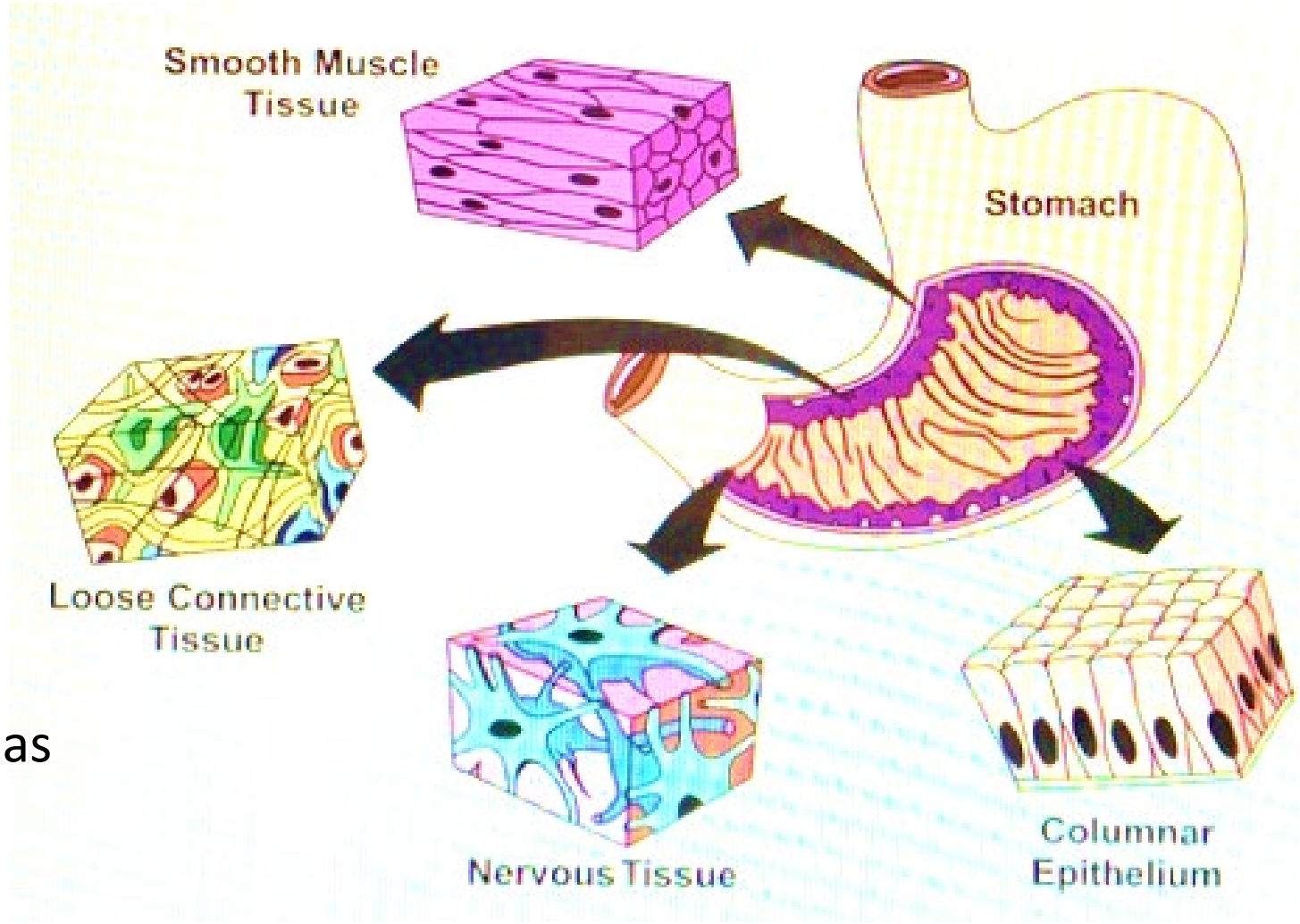


Where do they fit in?



Organs

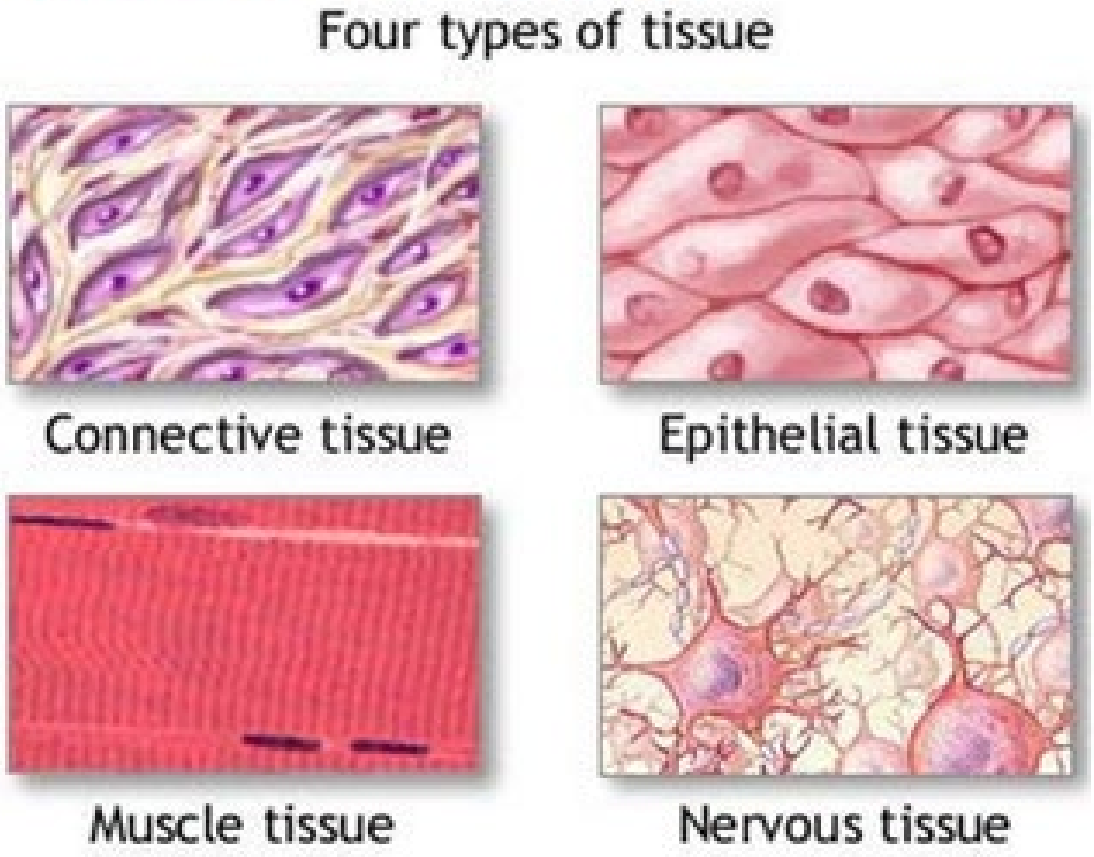
Associations of different *tissues* to perform a common function.
Stomach includes all 4 tissues.



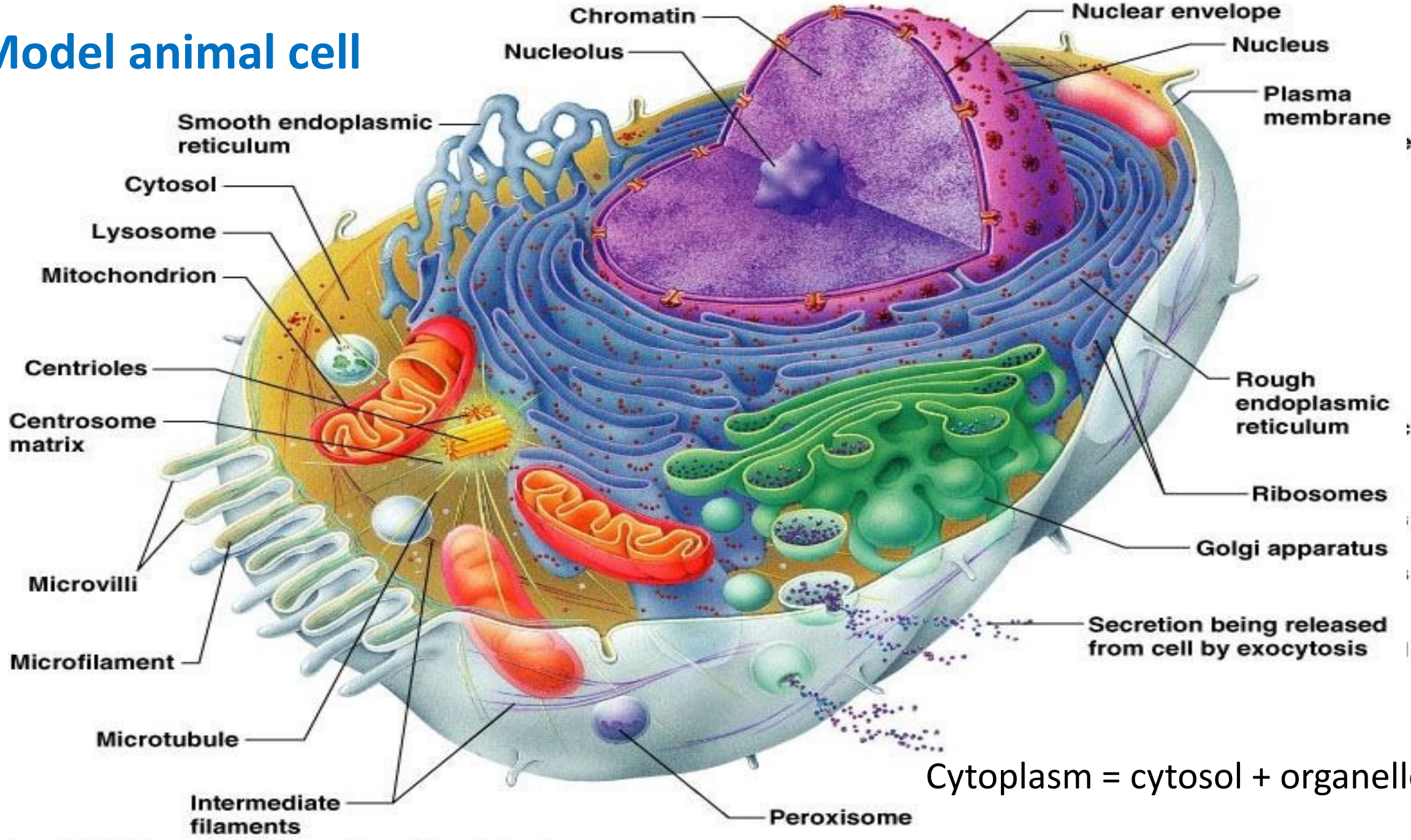
So, can't describe animal cells in isolation; need to talk about cells as they *communicate* in tissues and organs.

Tissues

- A tissue is a group of cells that perform the same structure & function



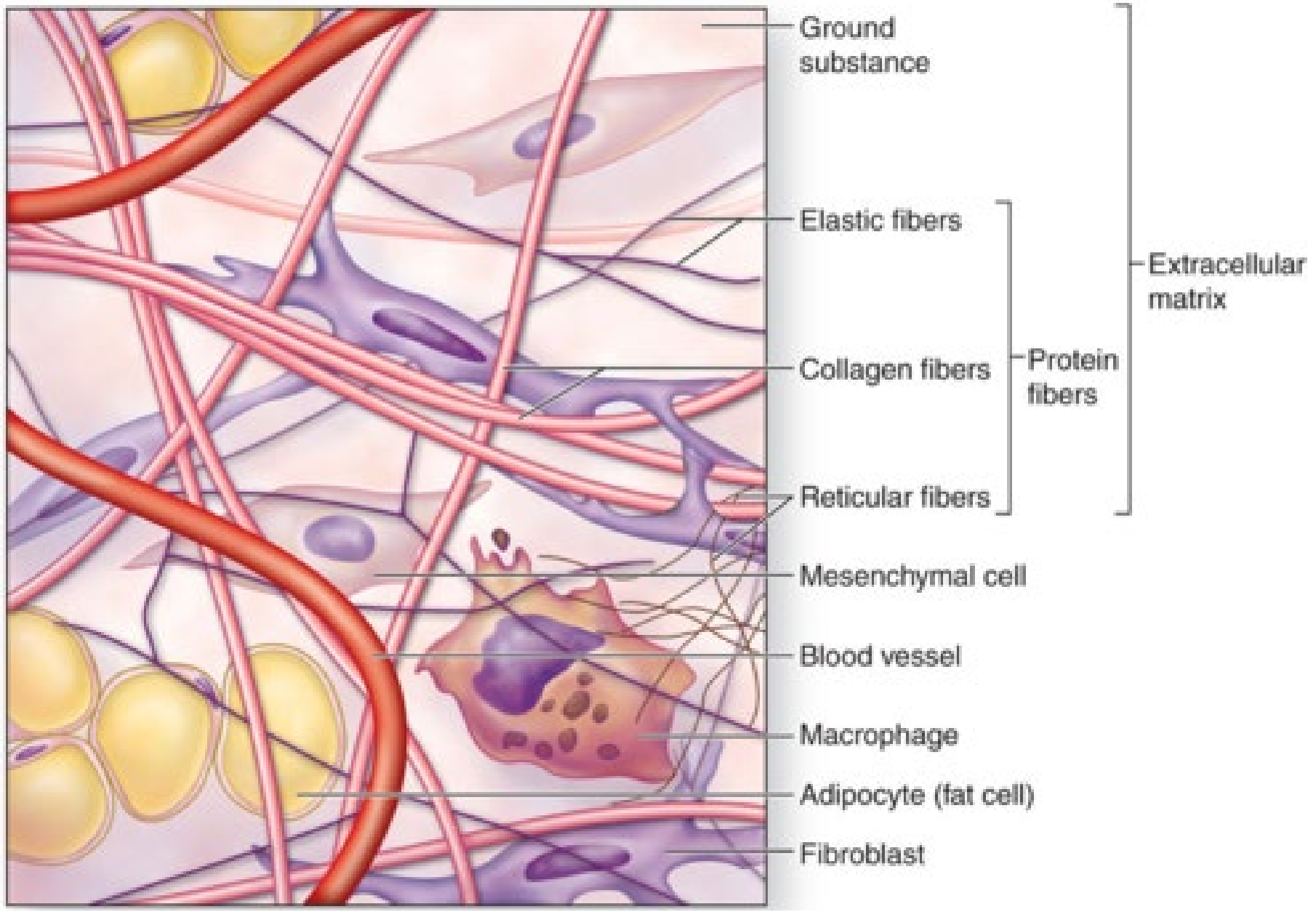
Model animal cell



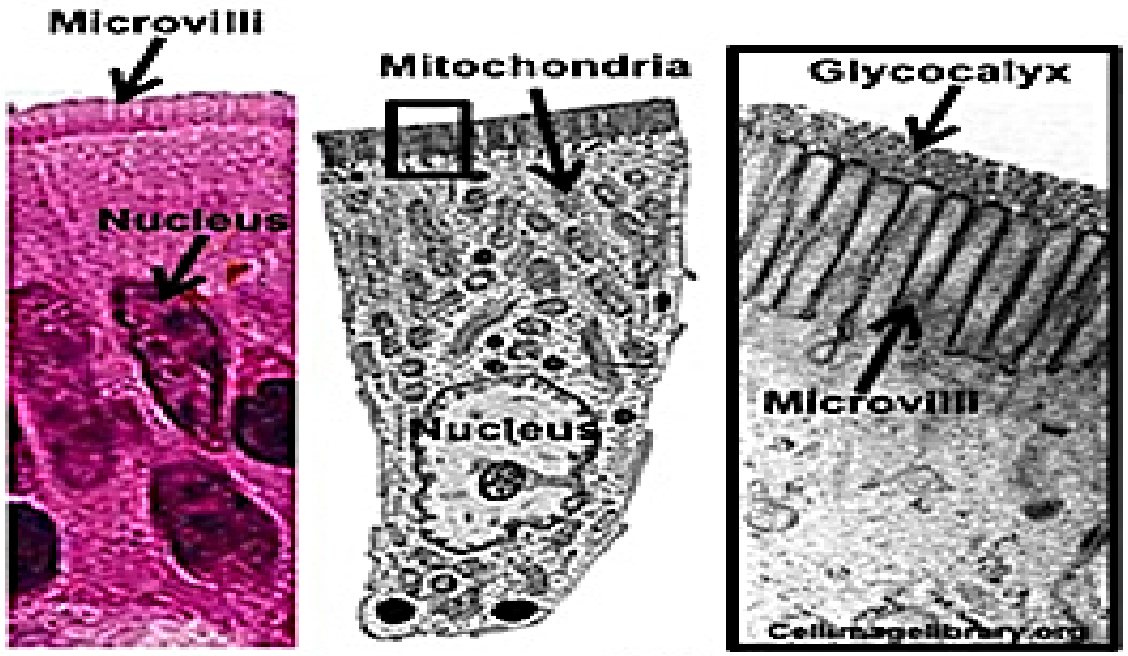
Cytoplasm = cytosol + organelles

Extracellular Matrix

Cells may contact each other directly or may be found in an extracellular matrix that is secreted by the cells.

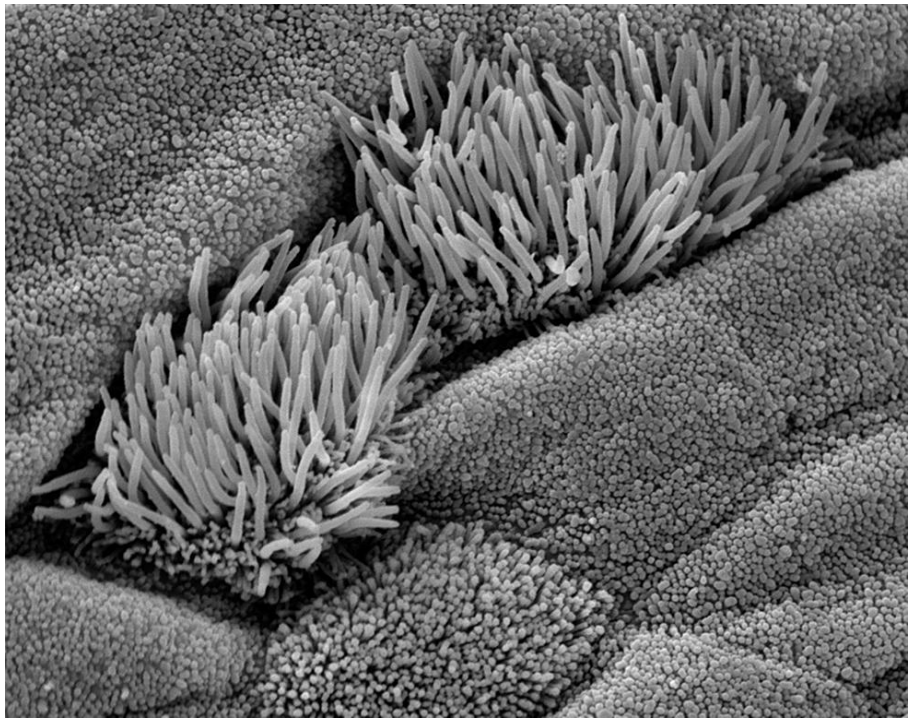


Microscopy

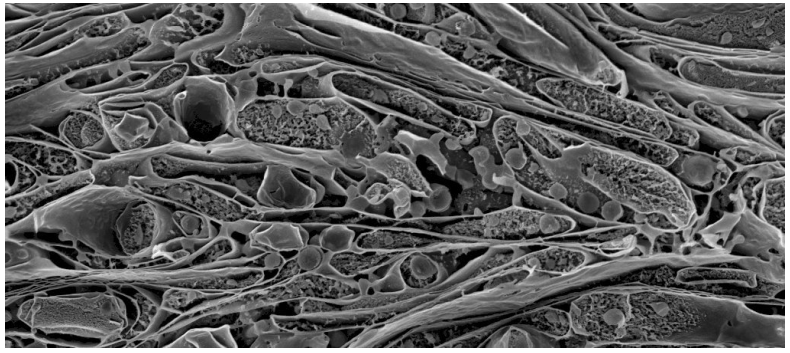


Light microscope vs. TEM images of intestinal epithelial cells

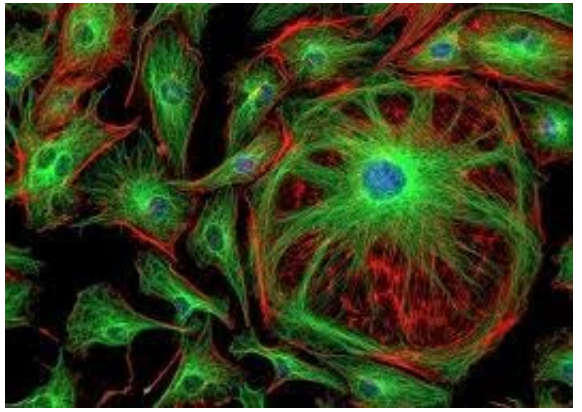
Transmission electron microscopy



Scanning electron microscopy



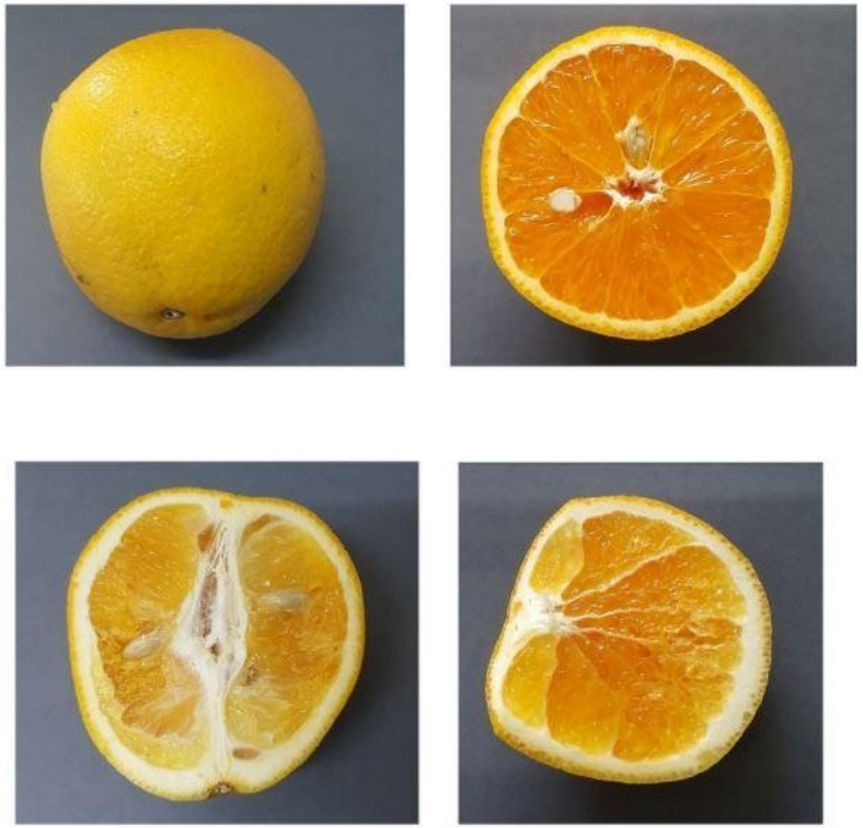
Freeze fracture EM

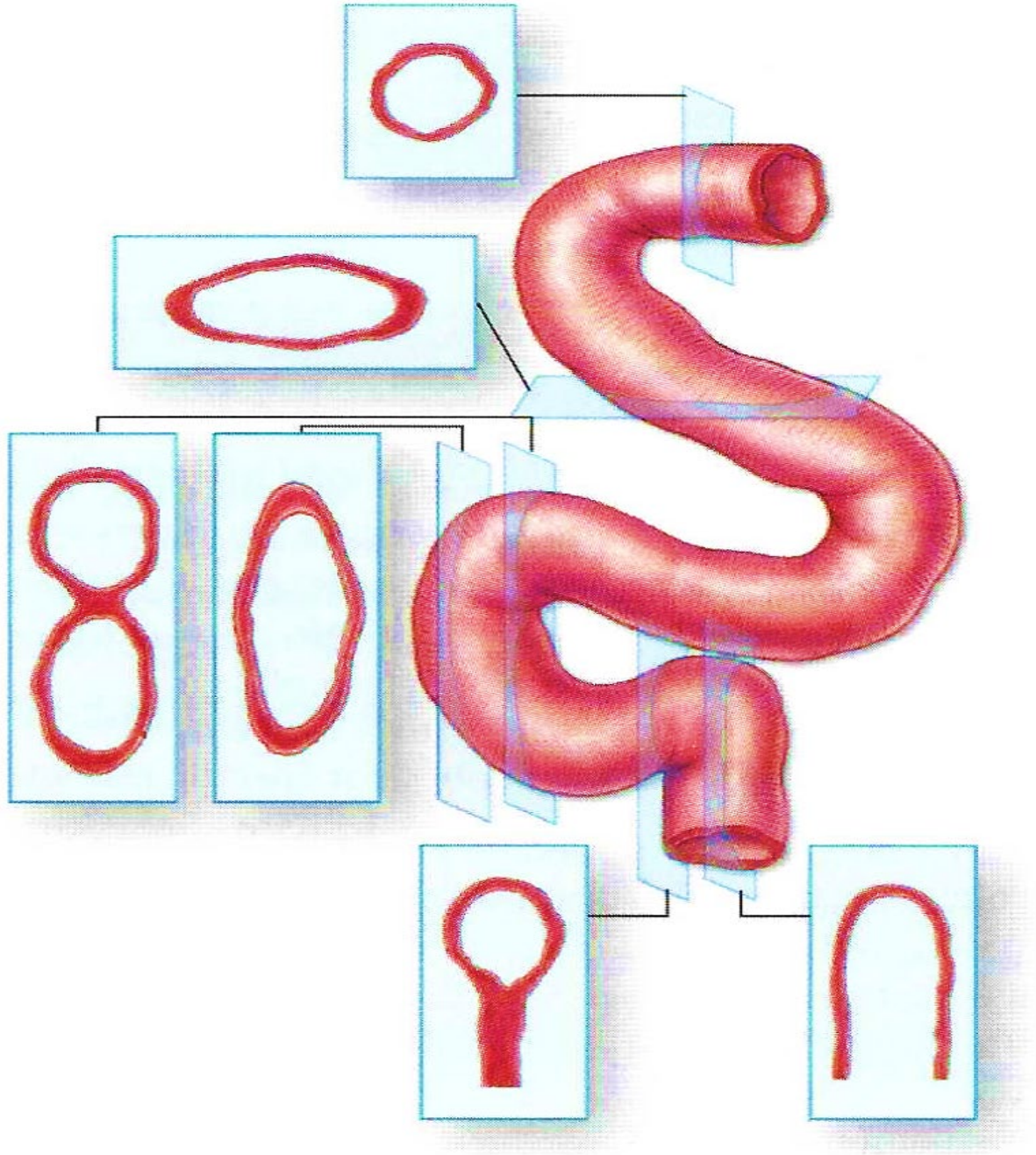


Florescent light microscopy

Videos in tissue culture

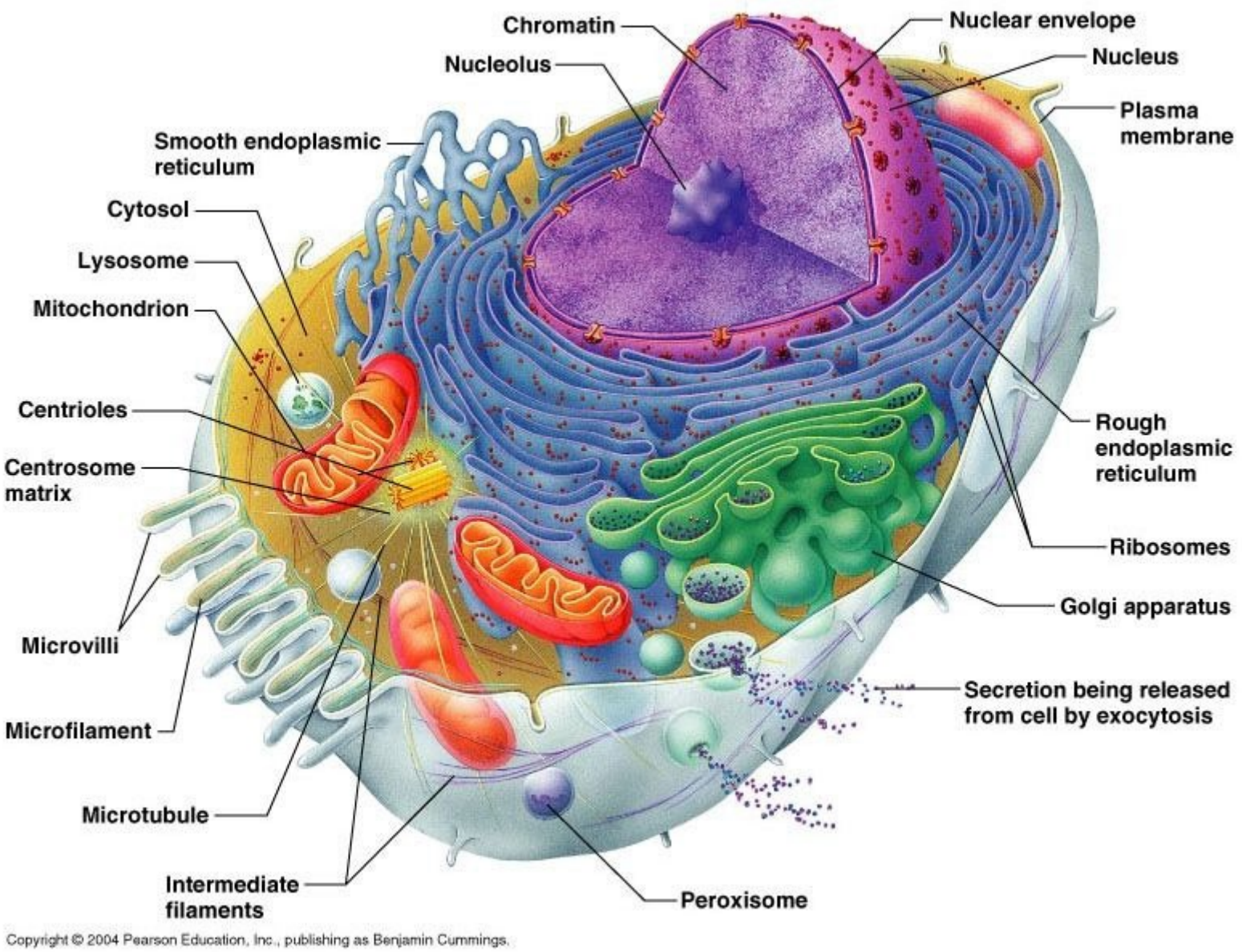
3 Dimensions from 2



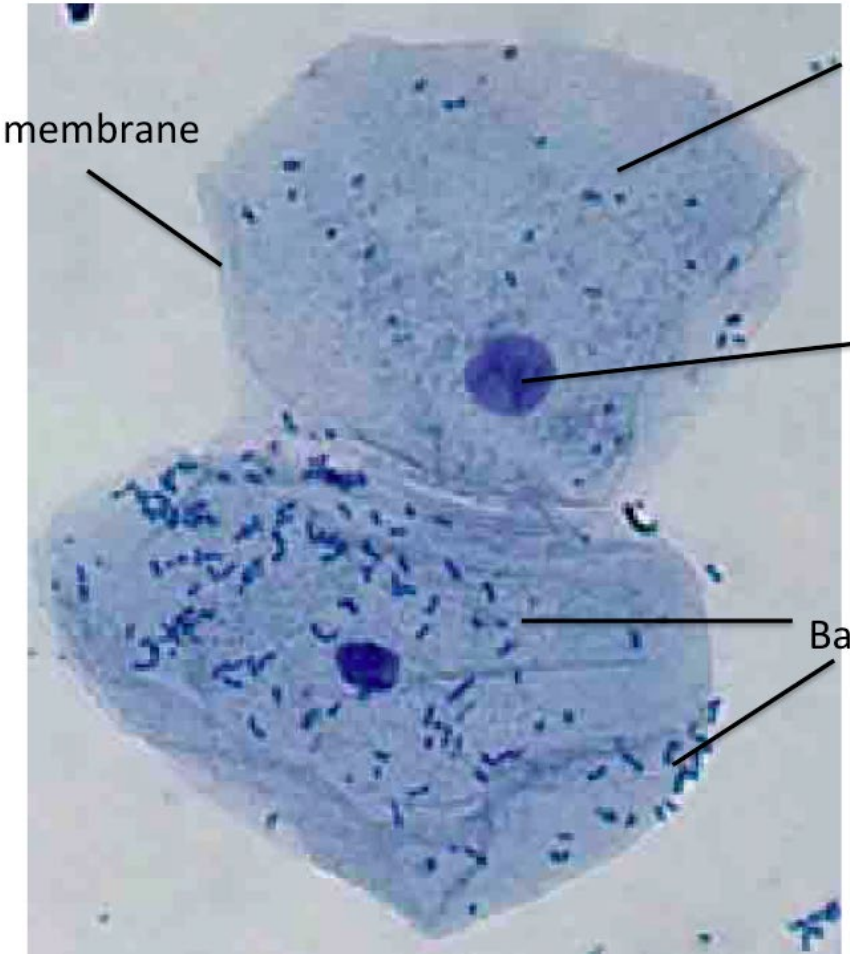


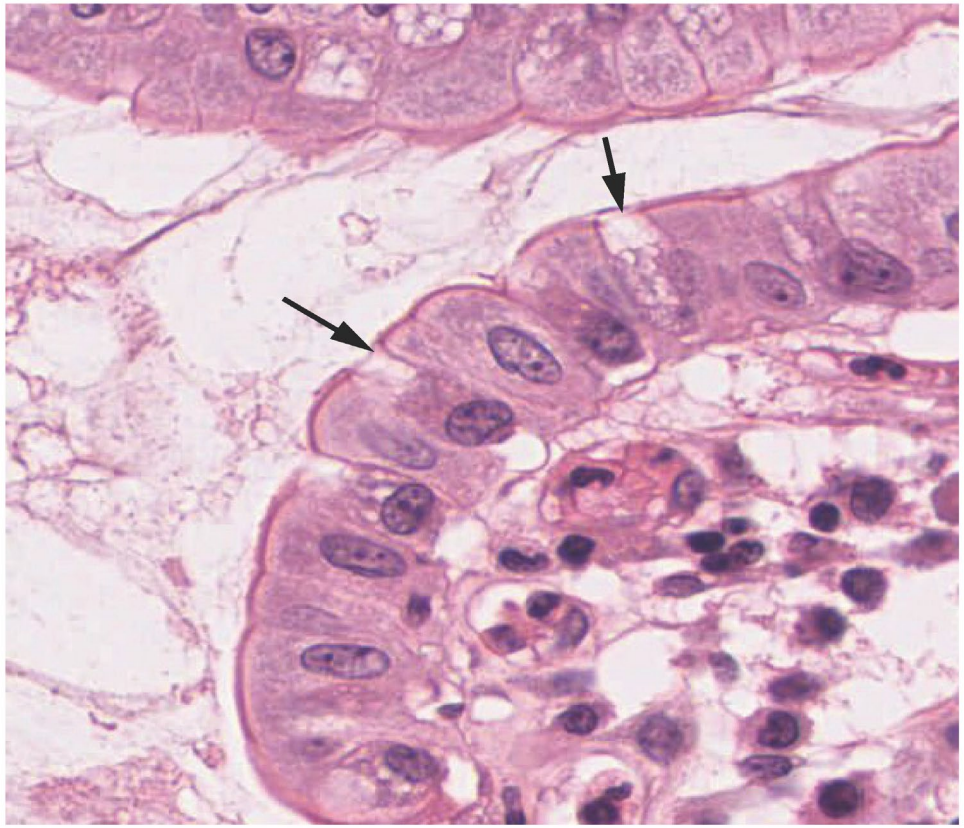
Cell Organization : like a city

All the different kinds of cells in our body have varying amounts of the same basic organelles.



Wall: Plasma Membrane



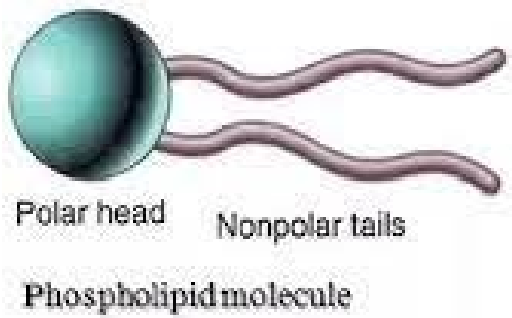


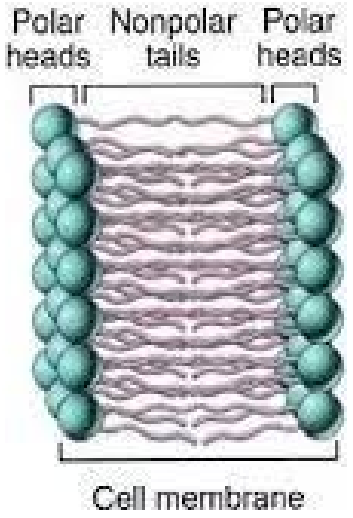
Light microscope

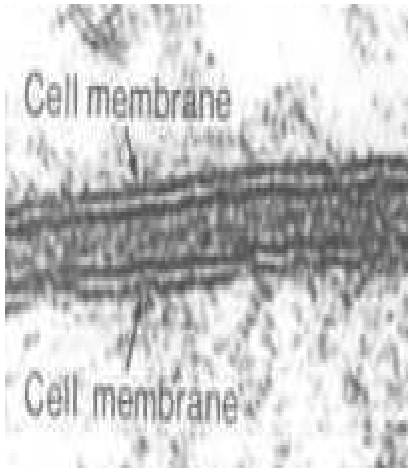
Transmission electron microscope

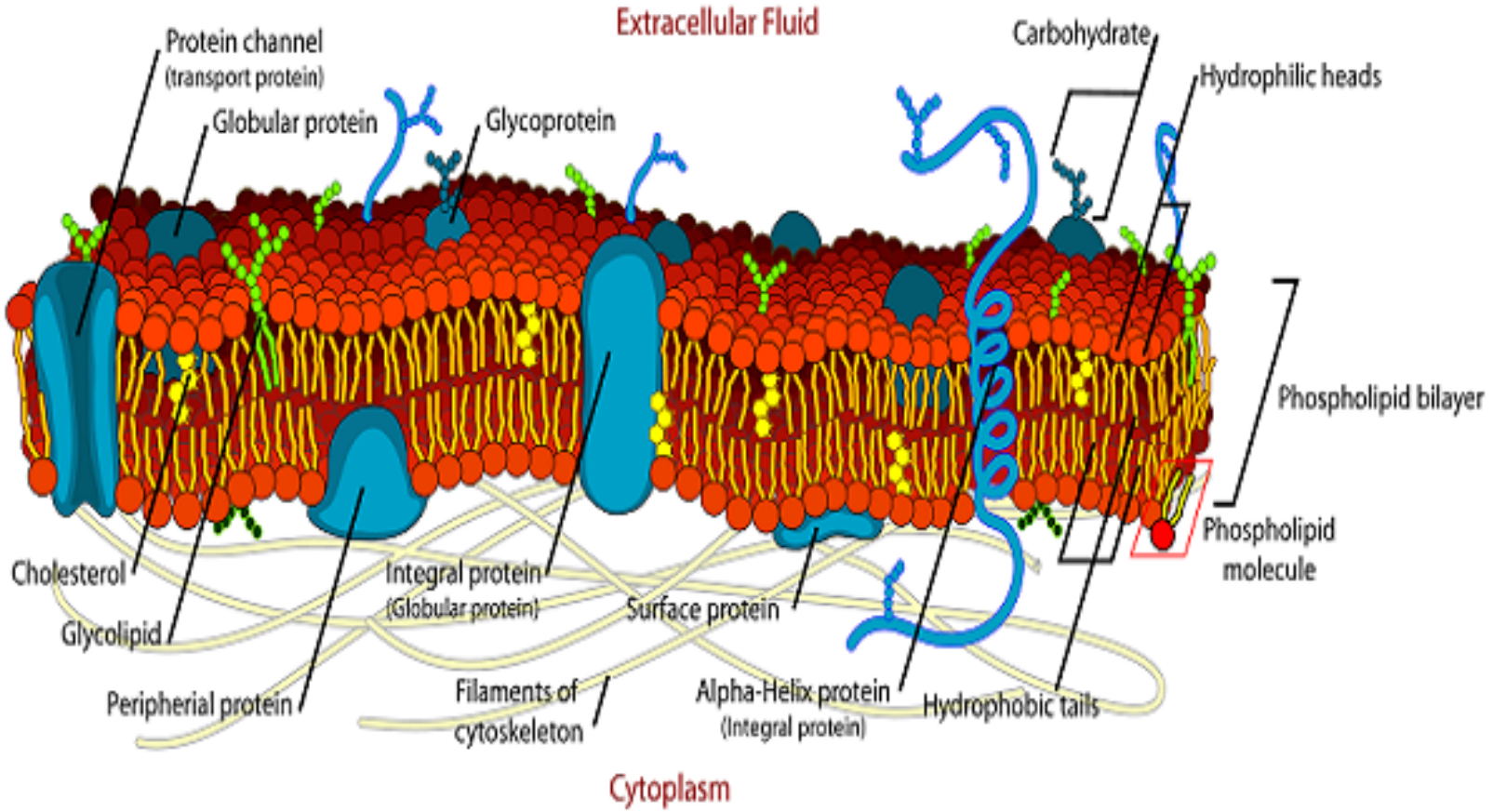
Wall: semi-permeable phospholipid bilayer

Control of what goes in and out; control concentrations. No charged (polar) or large molecules can pass without special **channels.** Contents of cell strictly controlled.



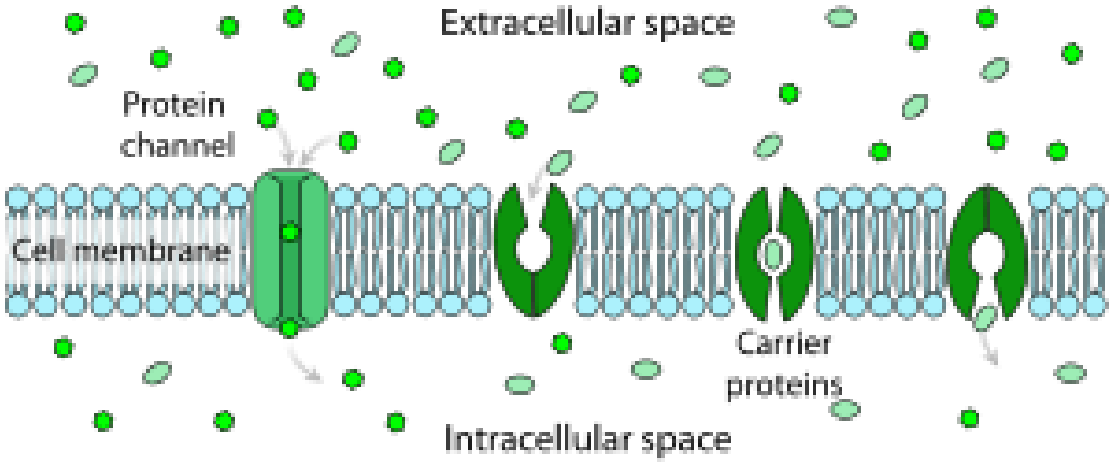


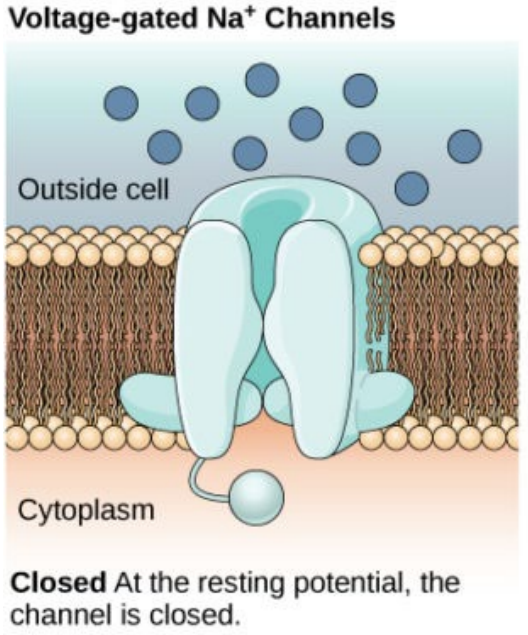


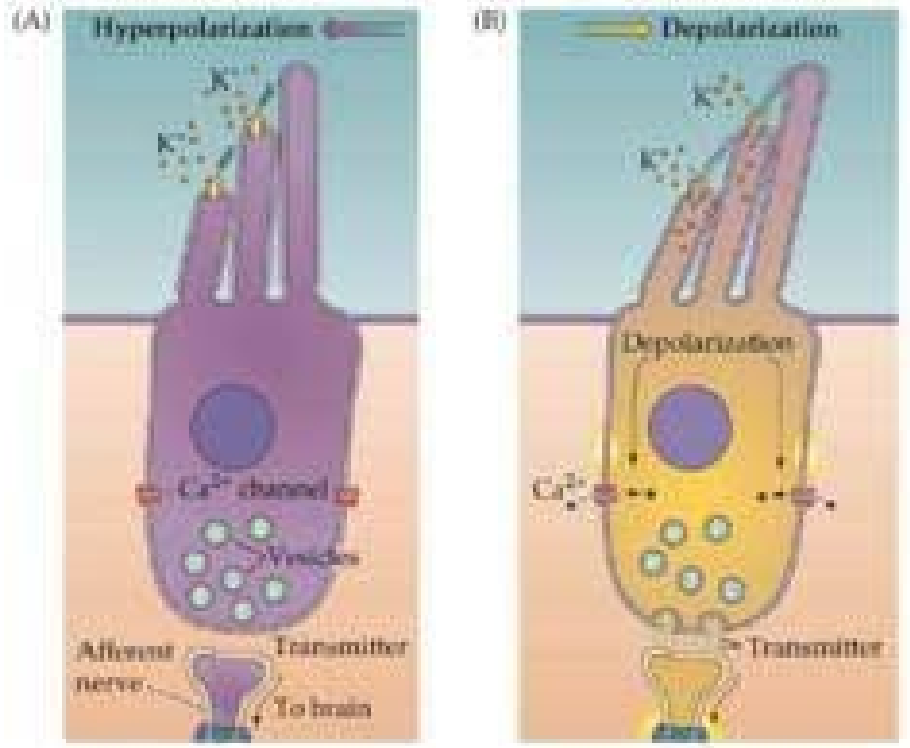


Gates: Channels

Channels can be opened by specific signals: change in voltage, mechanical stress, neurotransmitters. Also **carriers** that can carry specific nutrients across the membrane.



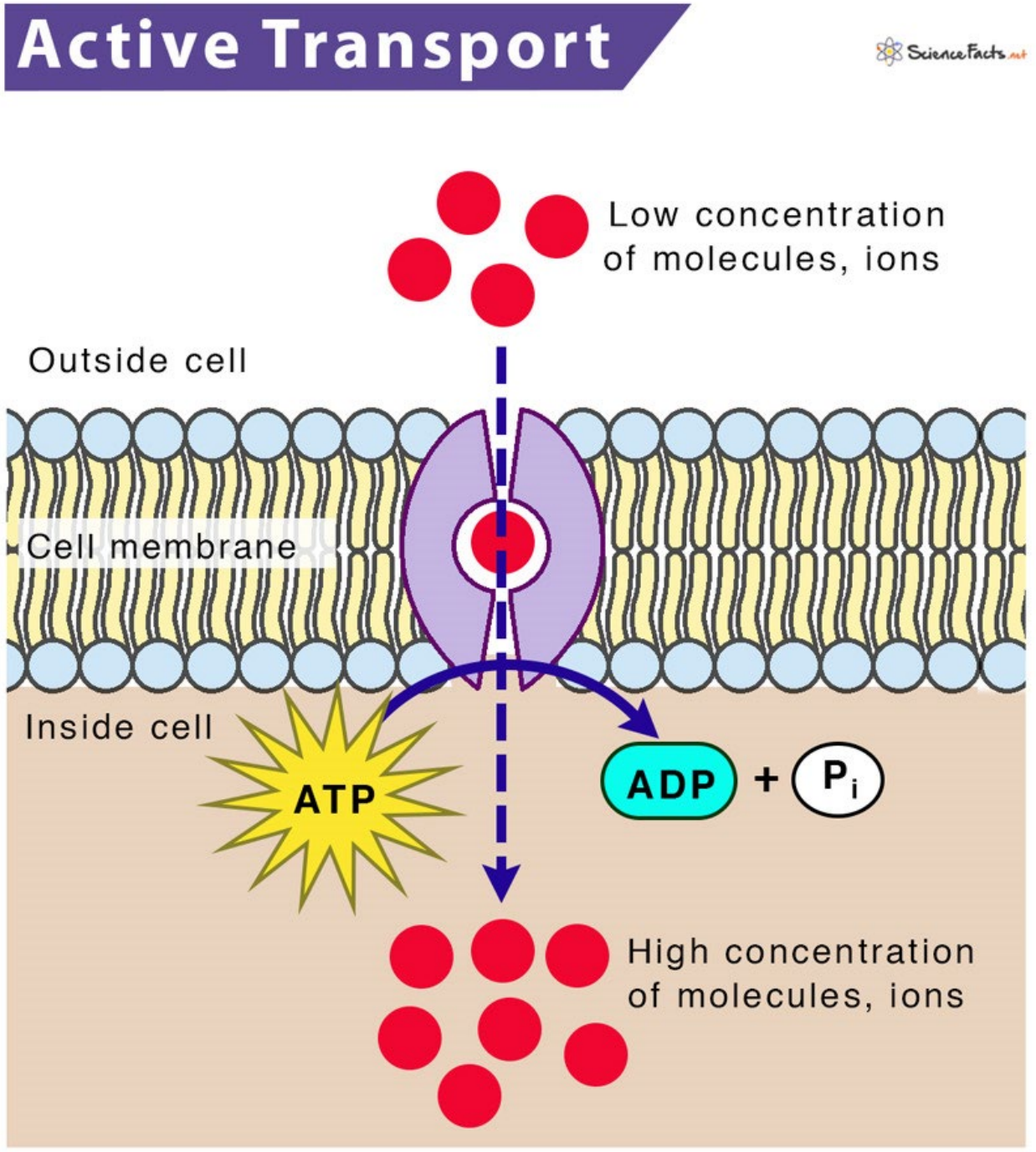




Hair cells in ear: vibrations open channels

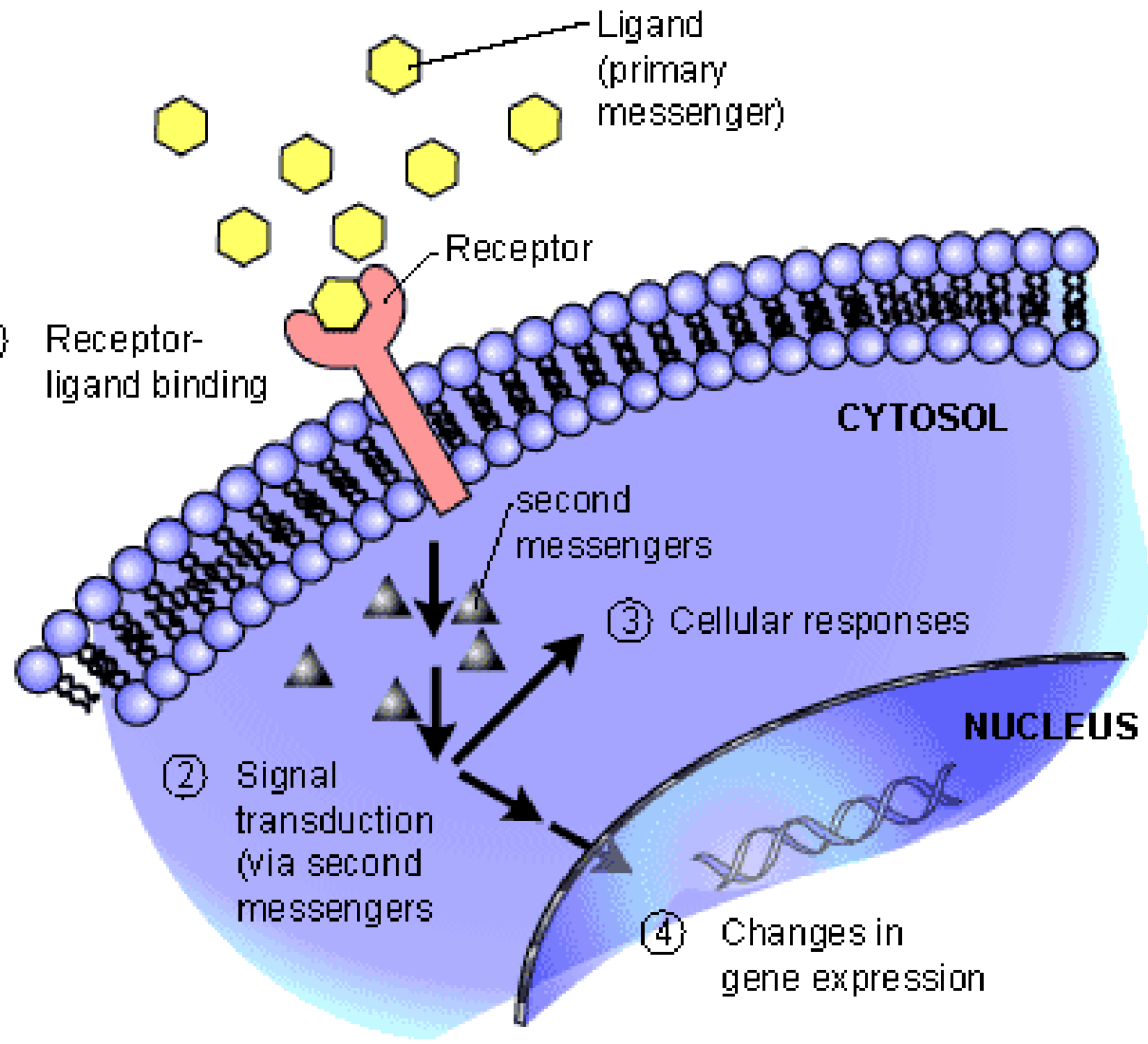
Pumps

Uses energy (**ATP**) to pump molecules across the membrane, even against a concentration gradient.



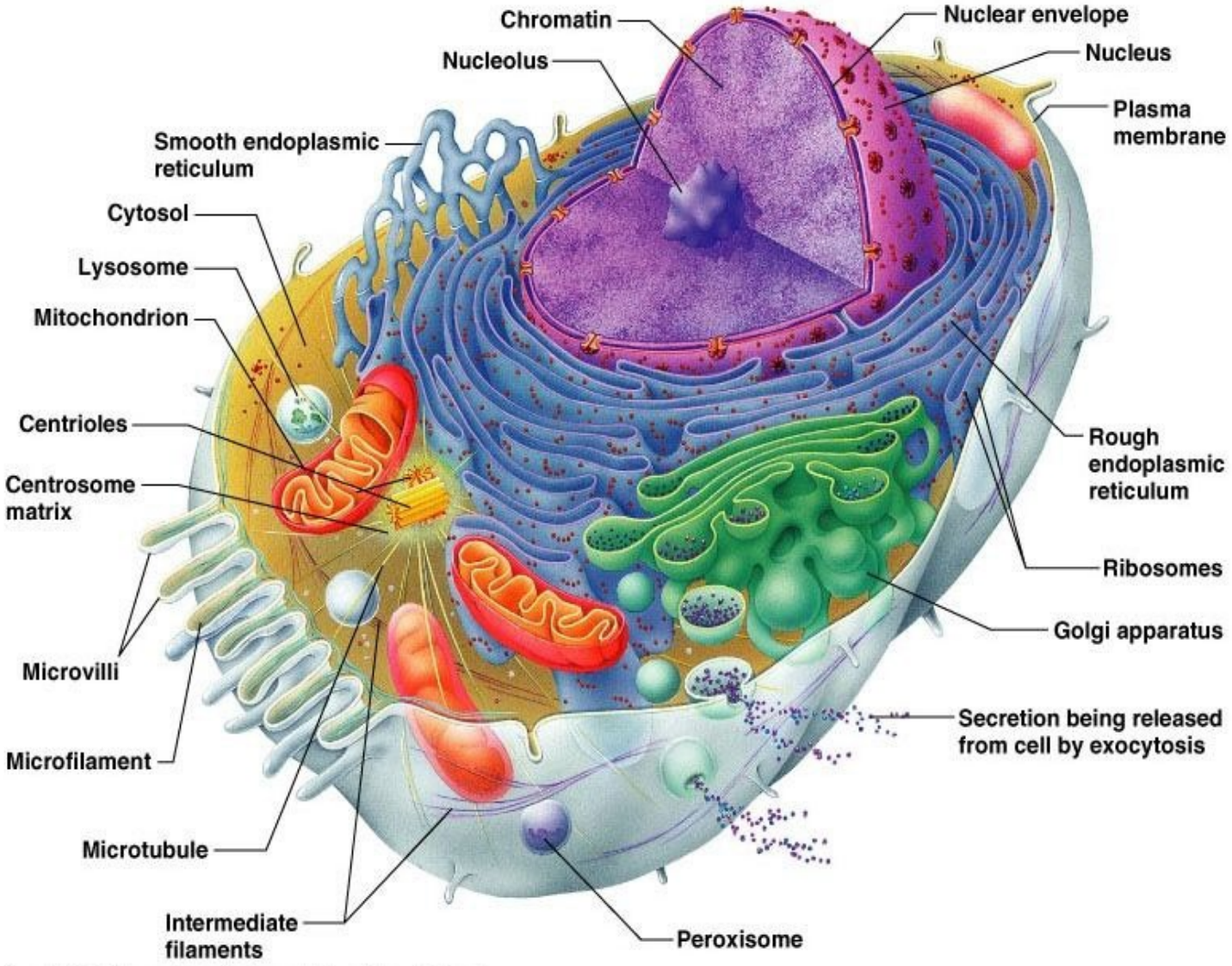
Antennae: Receptors

Receive messages from outside: hormones, nutrients, metabolites. Use to alter their own behavior, through control of which genes are actively expressed.



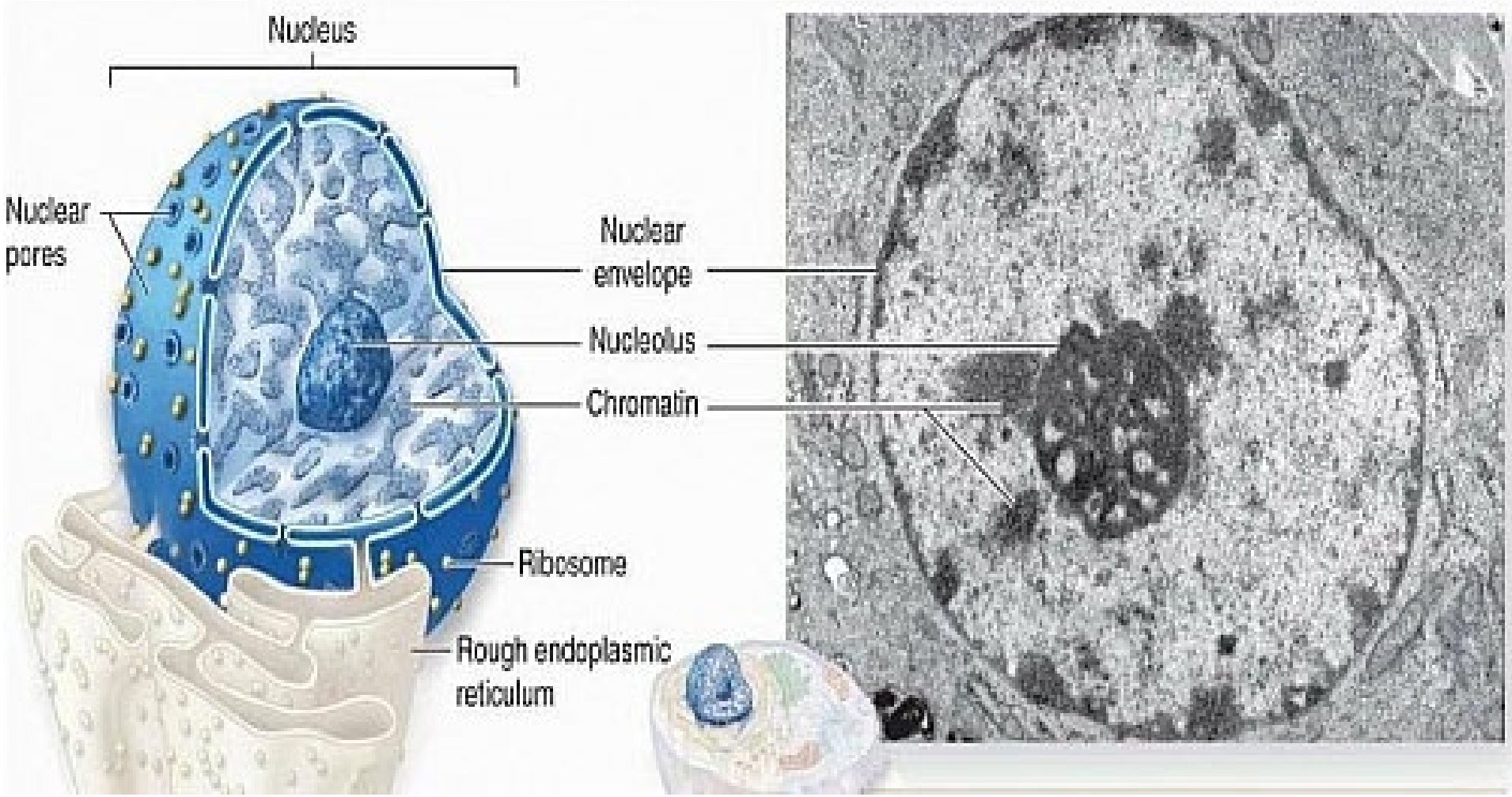
Neighborhoods: Compartments

Plasma membrane contains the cytoplasm: cytosol and organelles of the cell. Cytoplasm is filled with water and molecules that interact on a nanoscale, constantly colliding in a "molecular storm". How can these random interactions be controlled and directed into coherent processes? By membranes. Membranes select what goes across them, allowing different environments on each side. Many **organelles** of the cell are enclosed by membranes, concentrating the interactions inside.



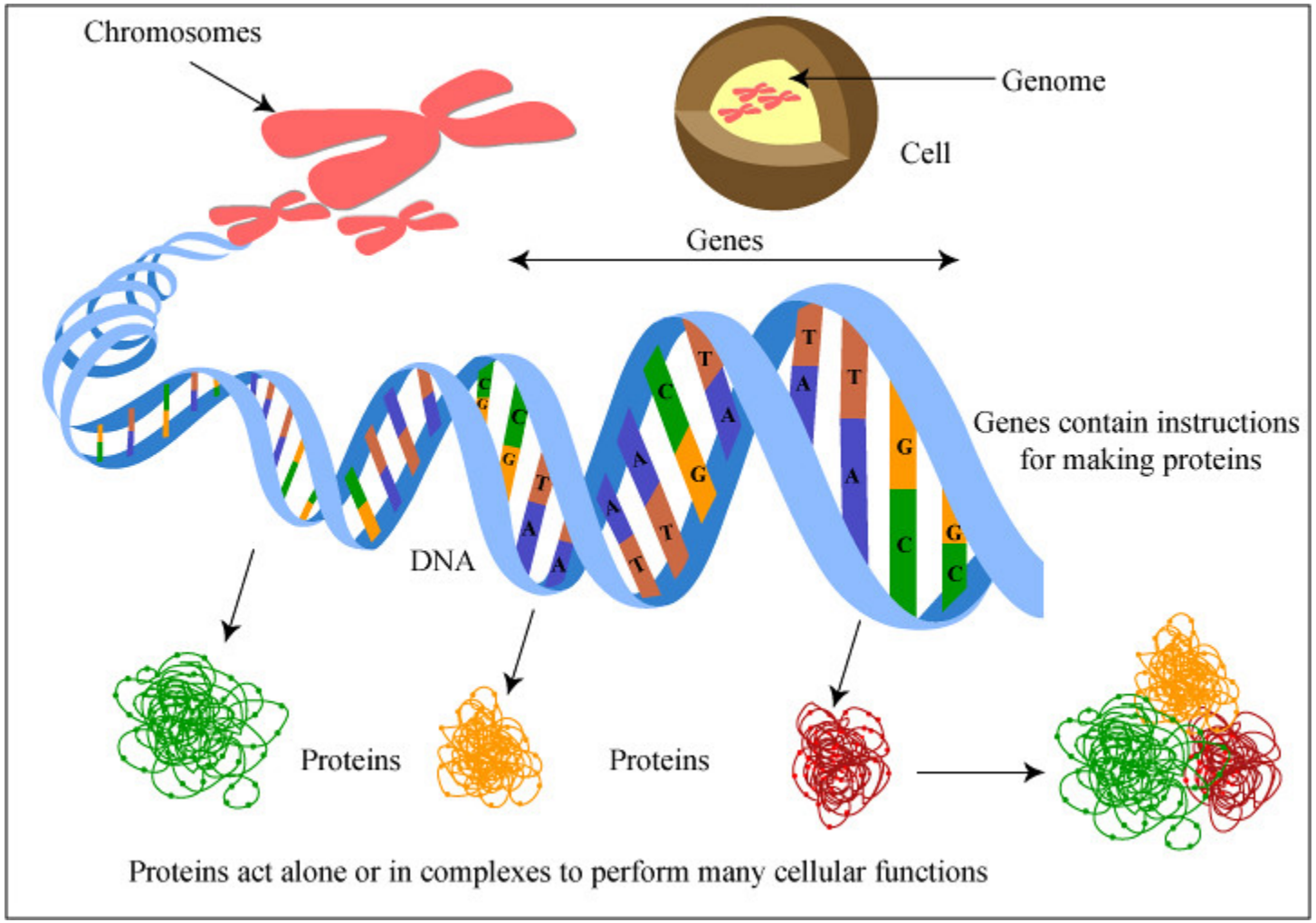
Library of Genes: Nucleus

Chromatin contains genes, which hold the information needed to make the cell. Enclosed by a nuclear membrane that has pores, so messengers can get into cytoplasm to direct protein synthesis.

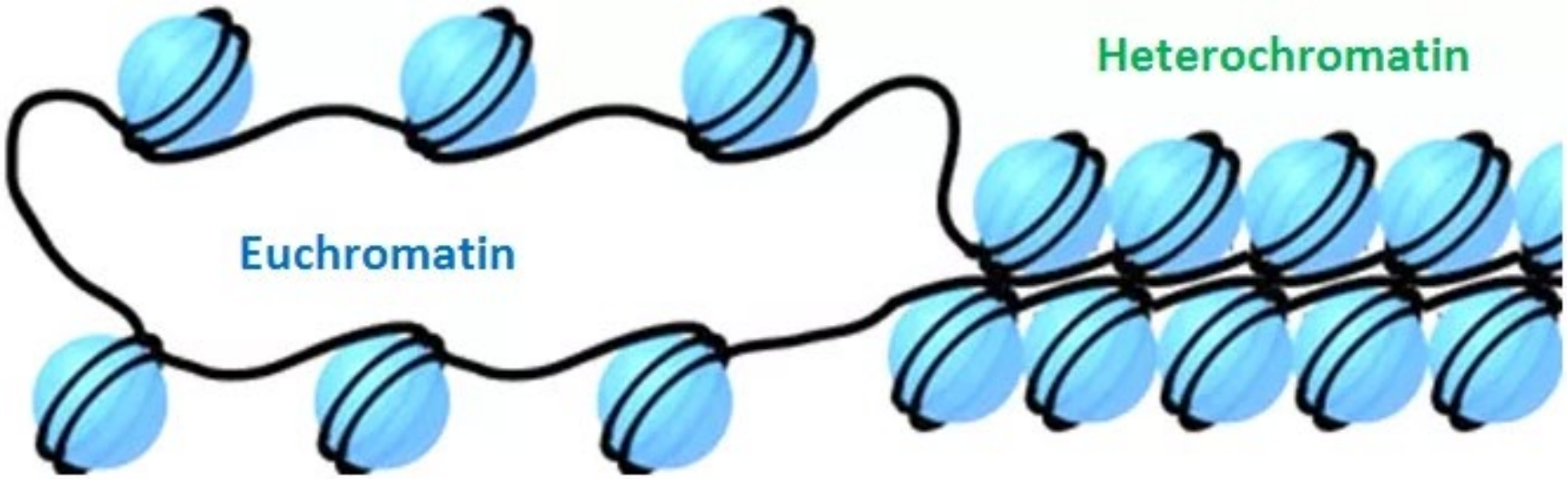


Books: Genes

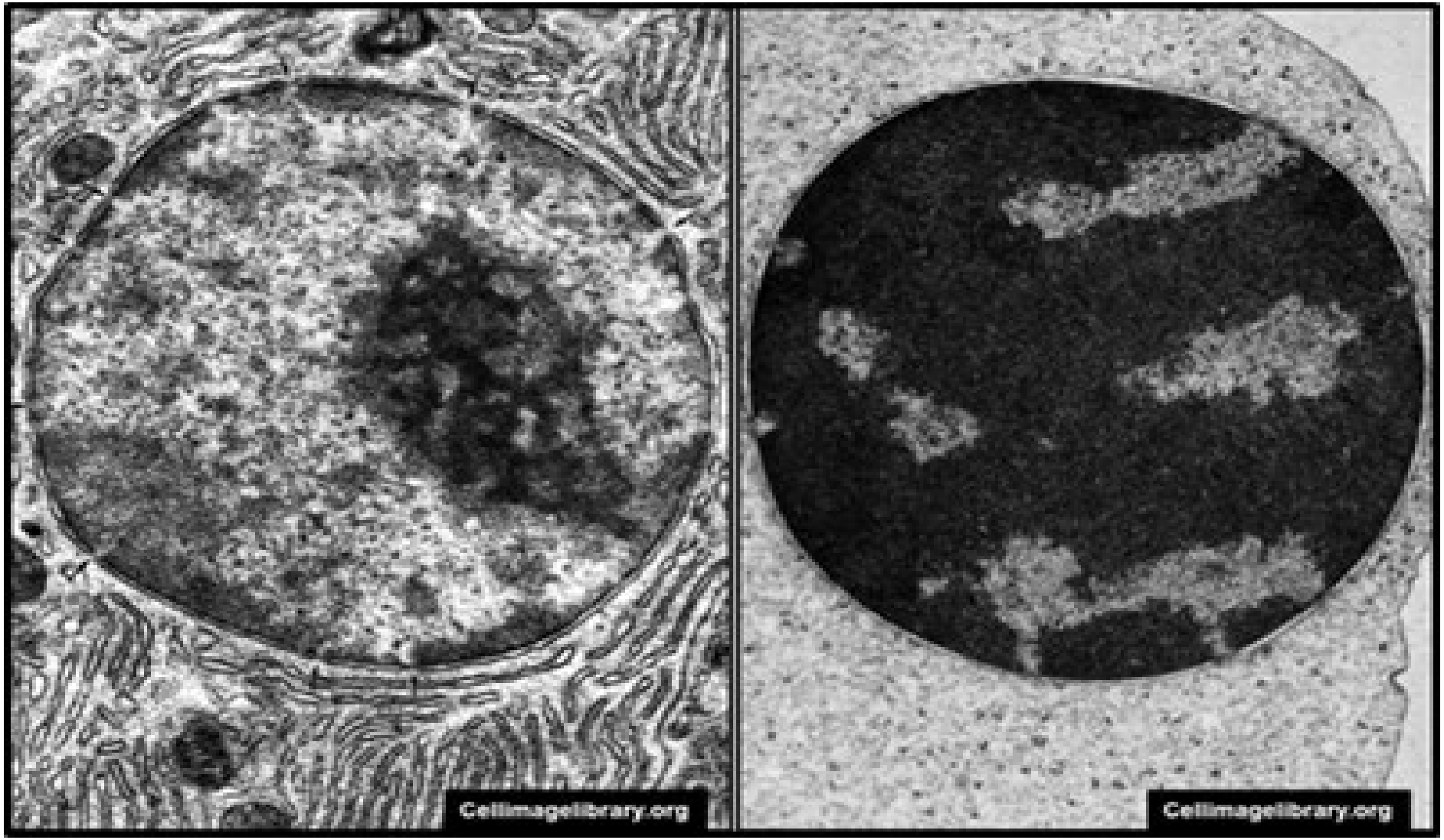
Genes are the portions of DNA that carry instructions to make a protein. Some are actively expressed, some are repressed.

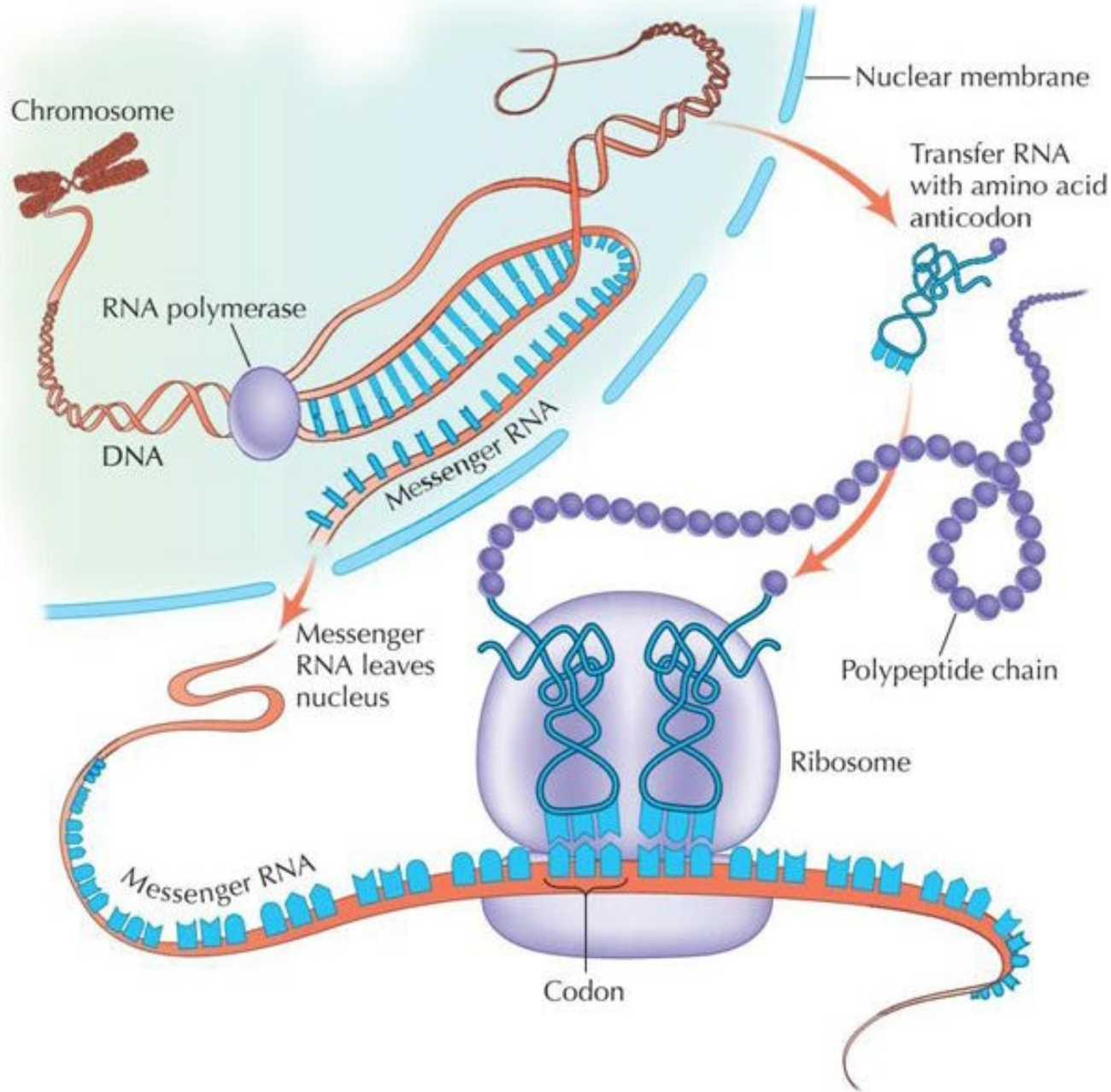


Active Genes



Euchromatin (left: pancreas cell making many proteins) vs
Heterochromatin (right: specialized blood cell, making only few proteins).





DNA

↓

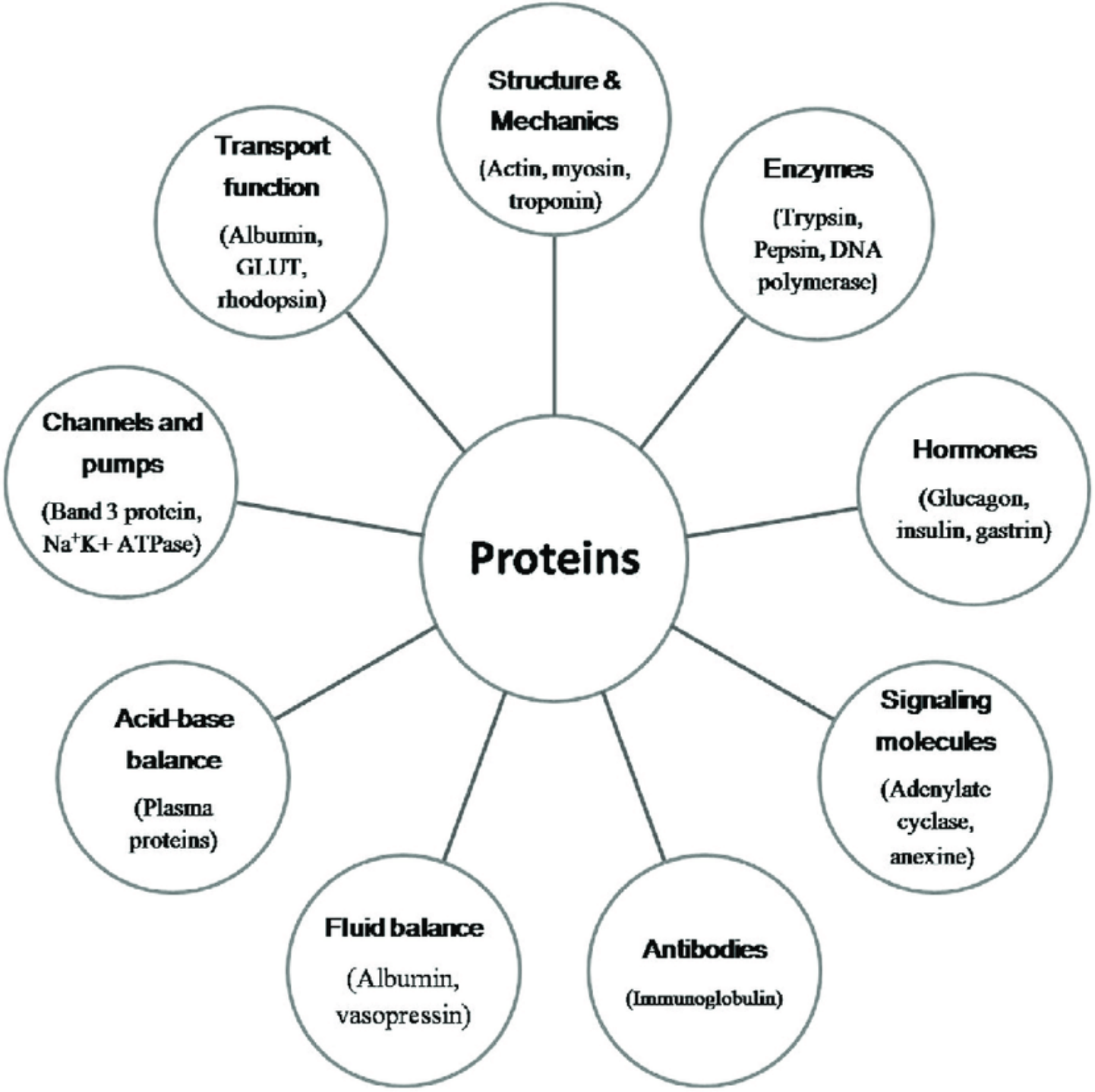
RNA

↓

PROTEIN

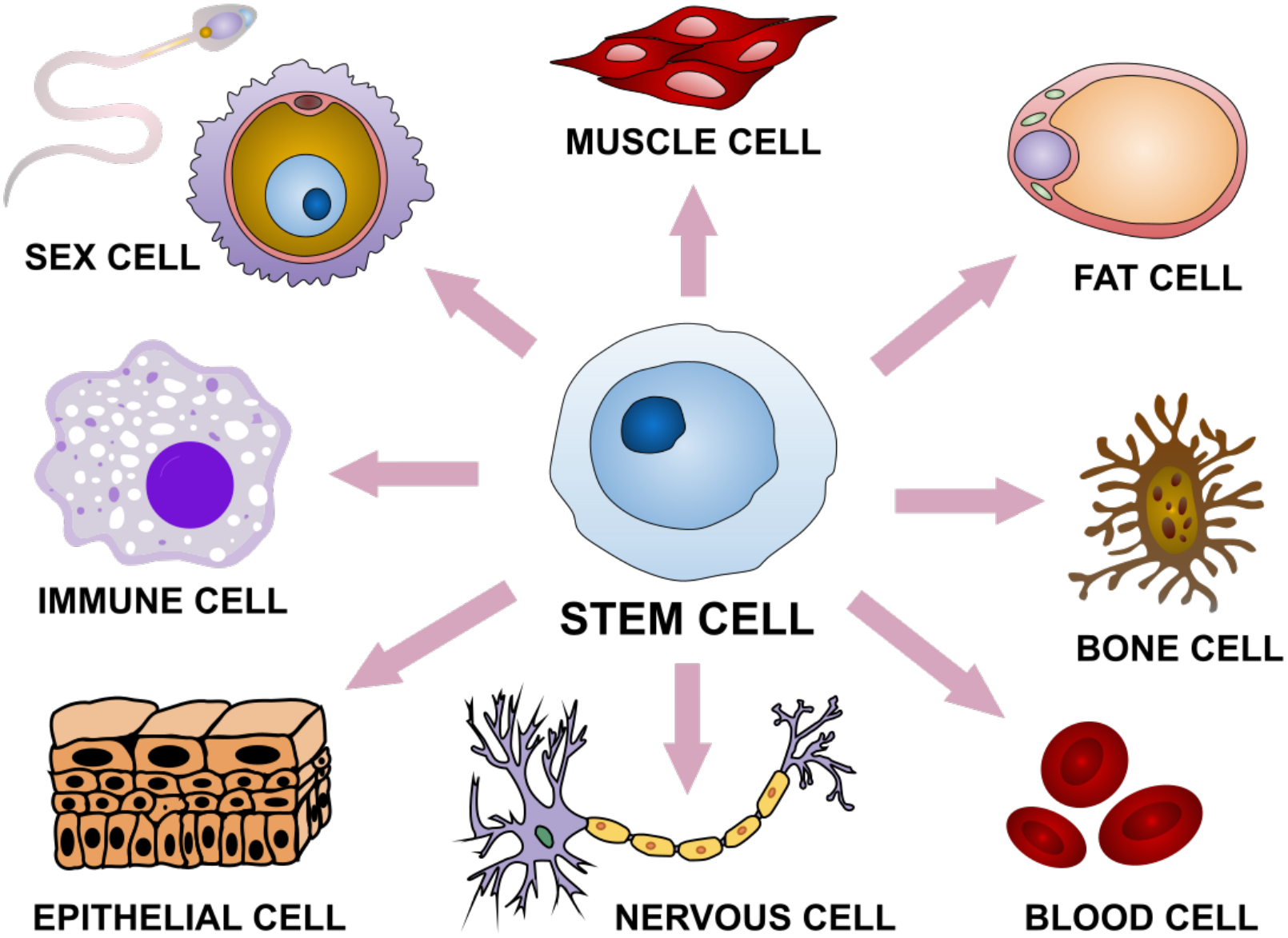
Proteins

In addition to providing the structure of a cell, proteins have many other roles.
An **enzyme** is a protein that facilitates a chemical reaction that would happen too slowly to be effective.
Controls the chemical reactions of metabolism.
Some proteins are **signaling molecules** that may take on different functions in different contexts.



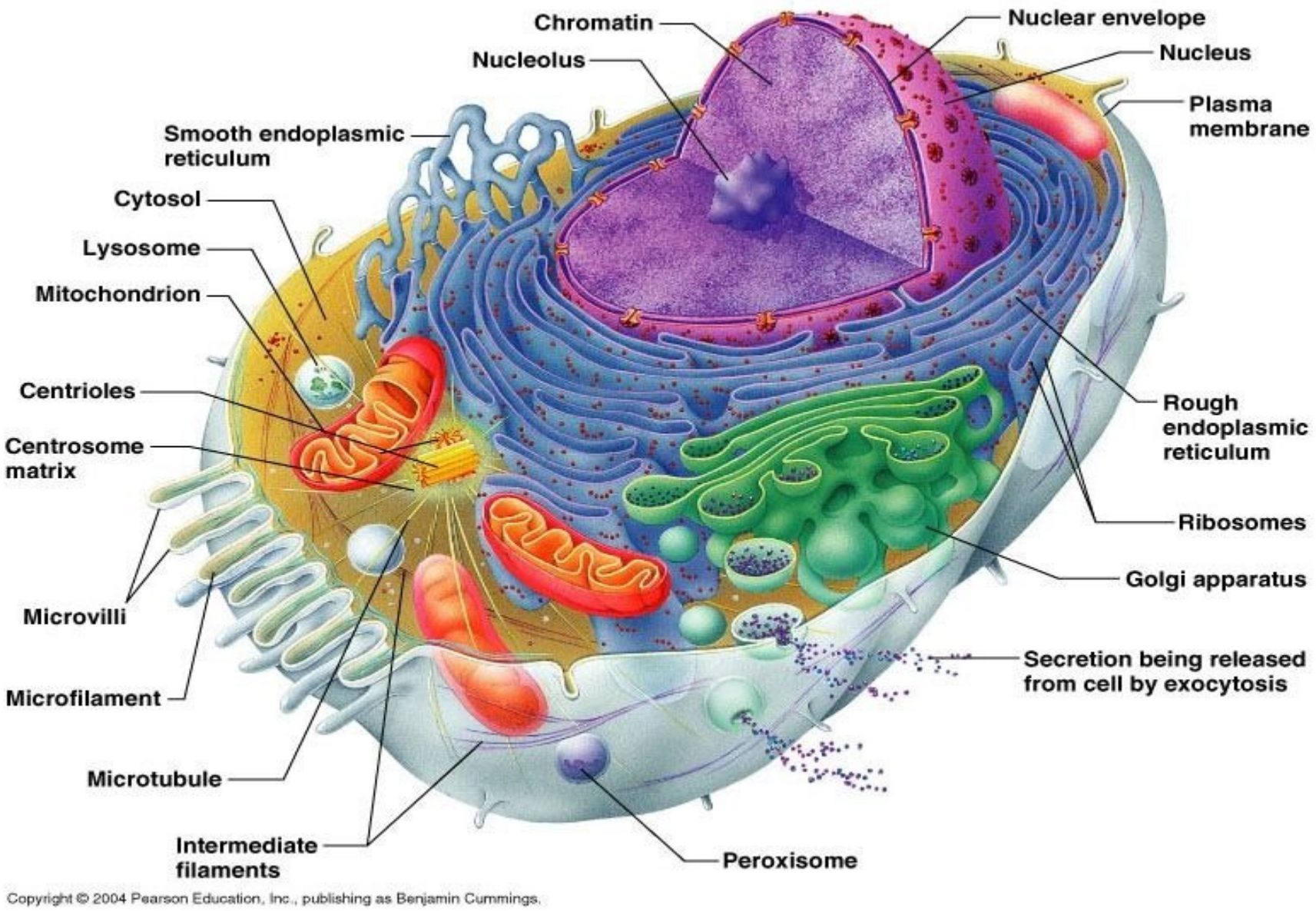
Gene Expression

All cells have the same genes, but not all are used. Different genes get expressed in different cell types. Also need to be expressed at right time.

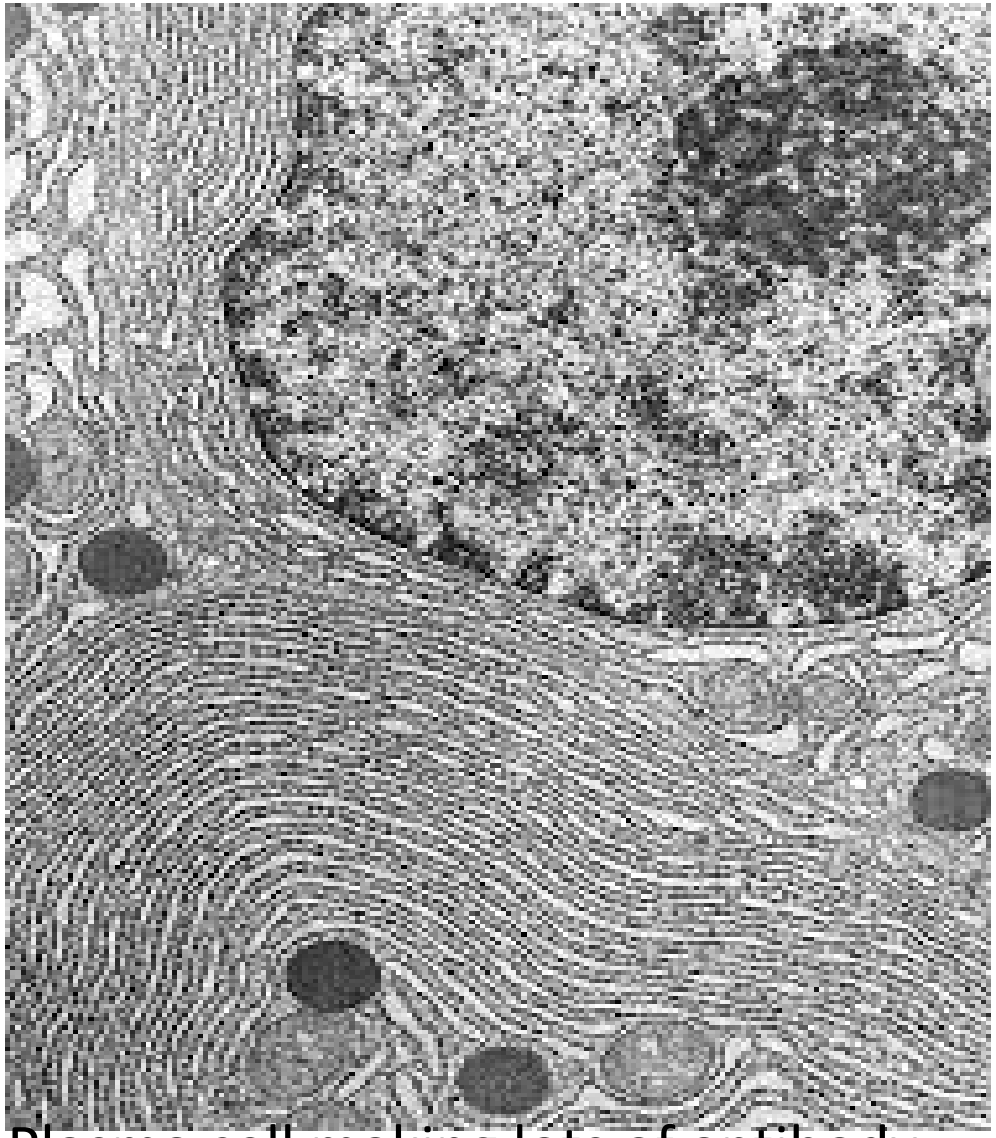


Factories: Rough Endoplasmic Reticulum (rER)

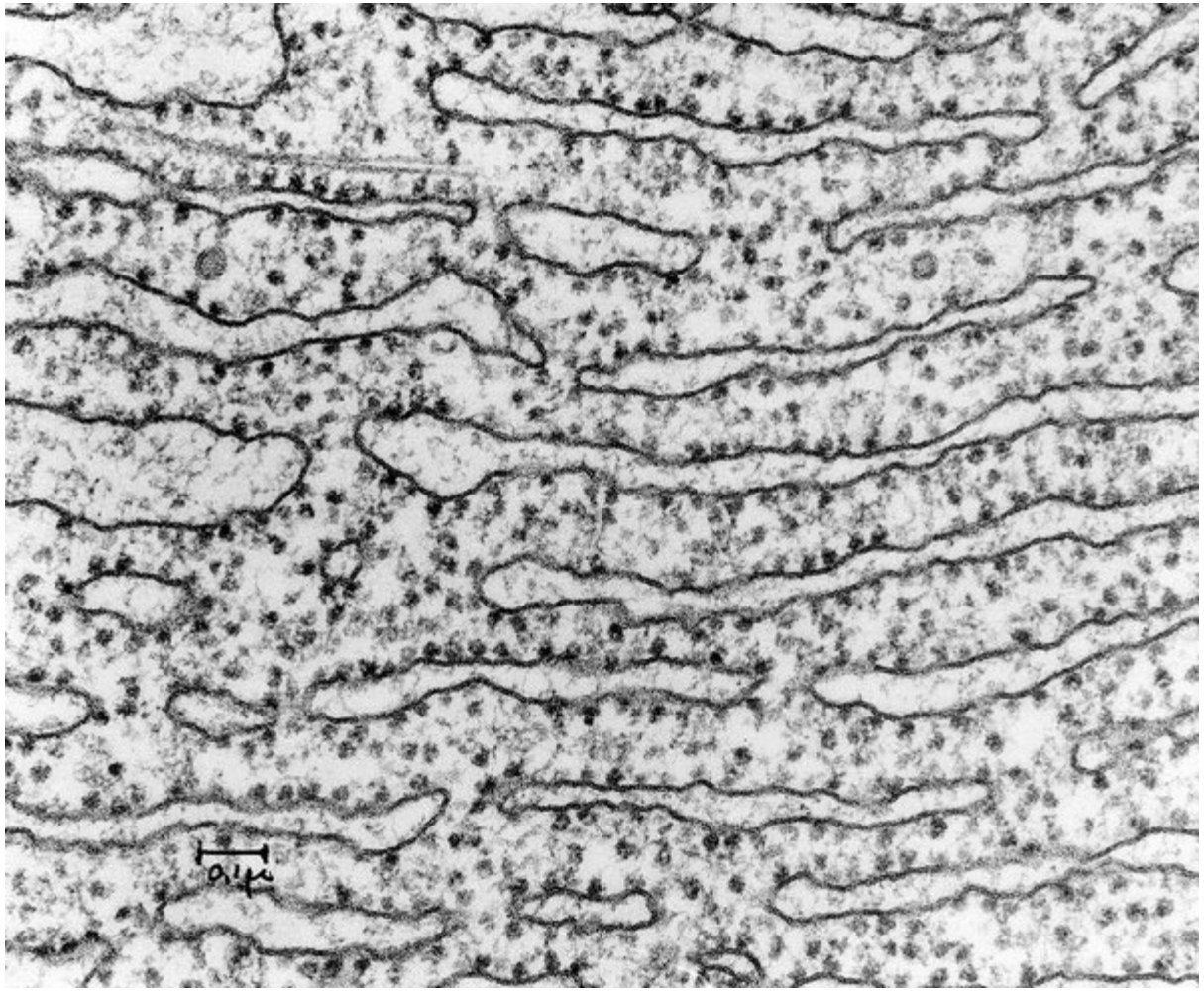
Flattened bags of membrane studded on outside with **ribosomes**. More in cells that make a lot of protein.



rER (rough endoplasmic reticulum)



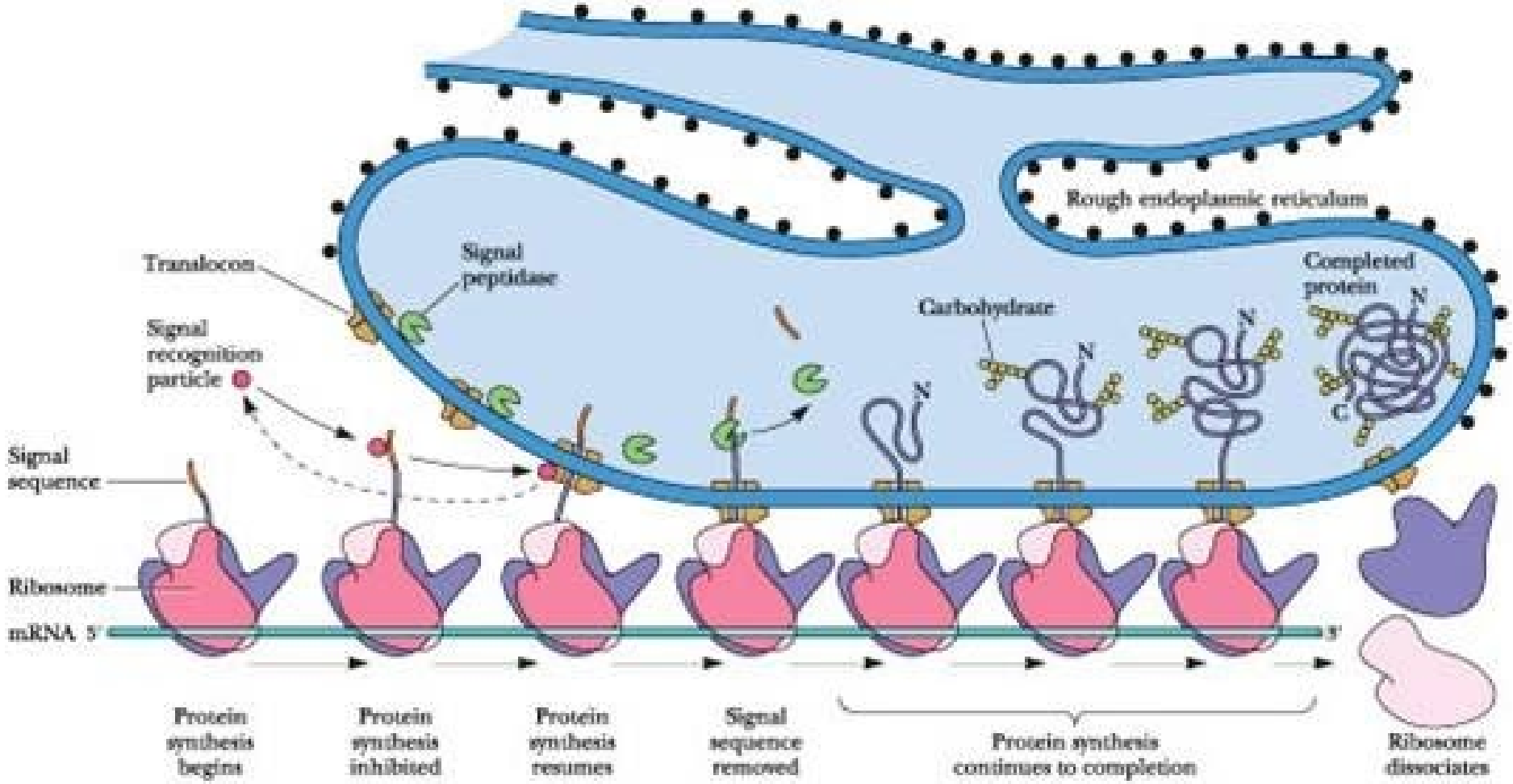
Plasma cell making lots of antibody



Ribosomes on outside of cisternae

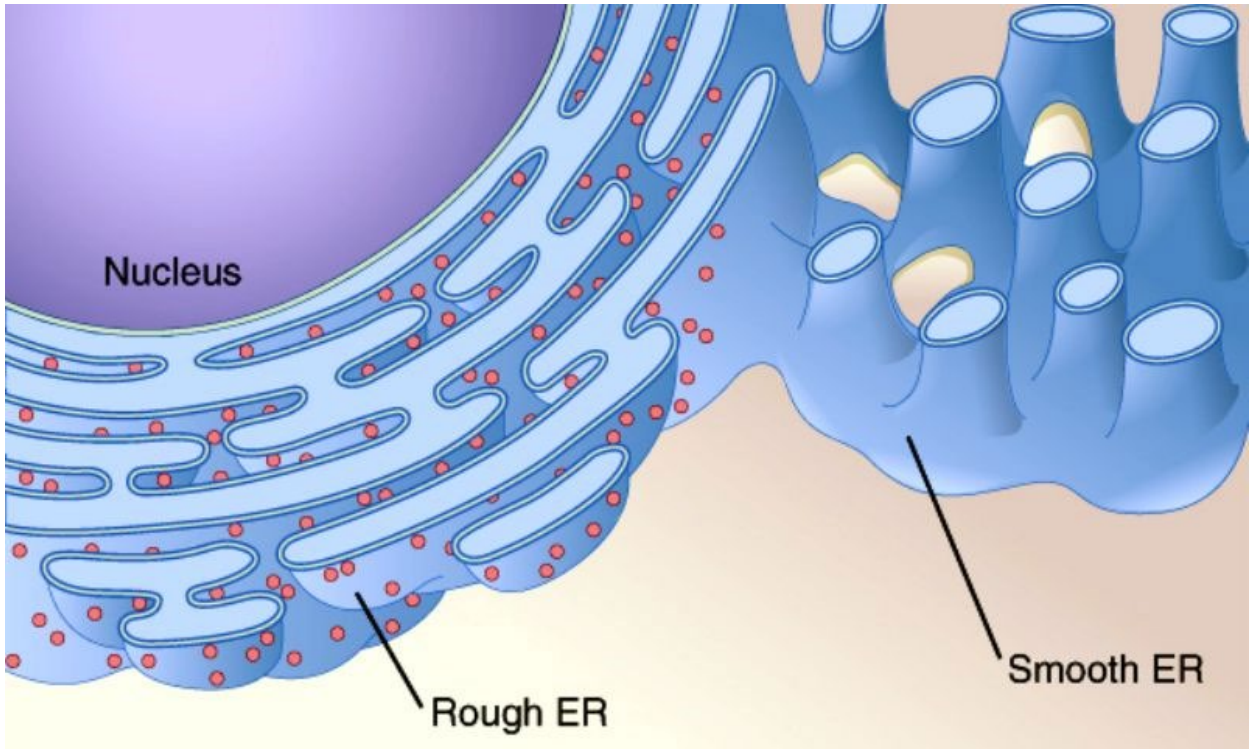
Ribosomes

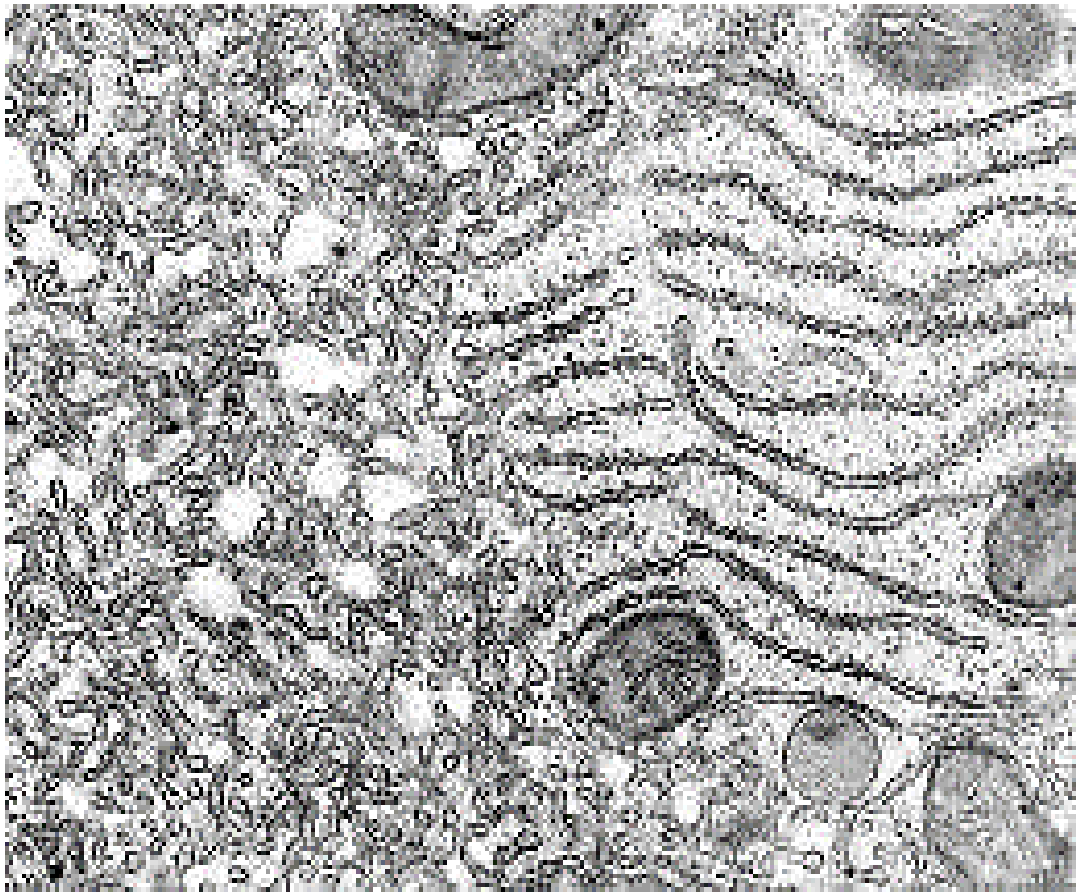
Ribosome reads the mRNA (messenger RNA) to make the right protein.
Ribosomes on rER send proteins into inside of rER, to be packaged.
Ribosomes that float free in cytoplasm make proteins used in cytoplasm.



Drug Treatment: Smooth Endoplasmic Reticulum

Detoxifies drugs, makes sex hormones .

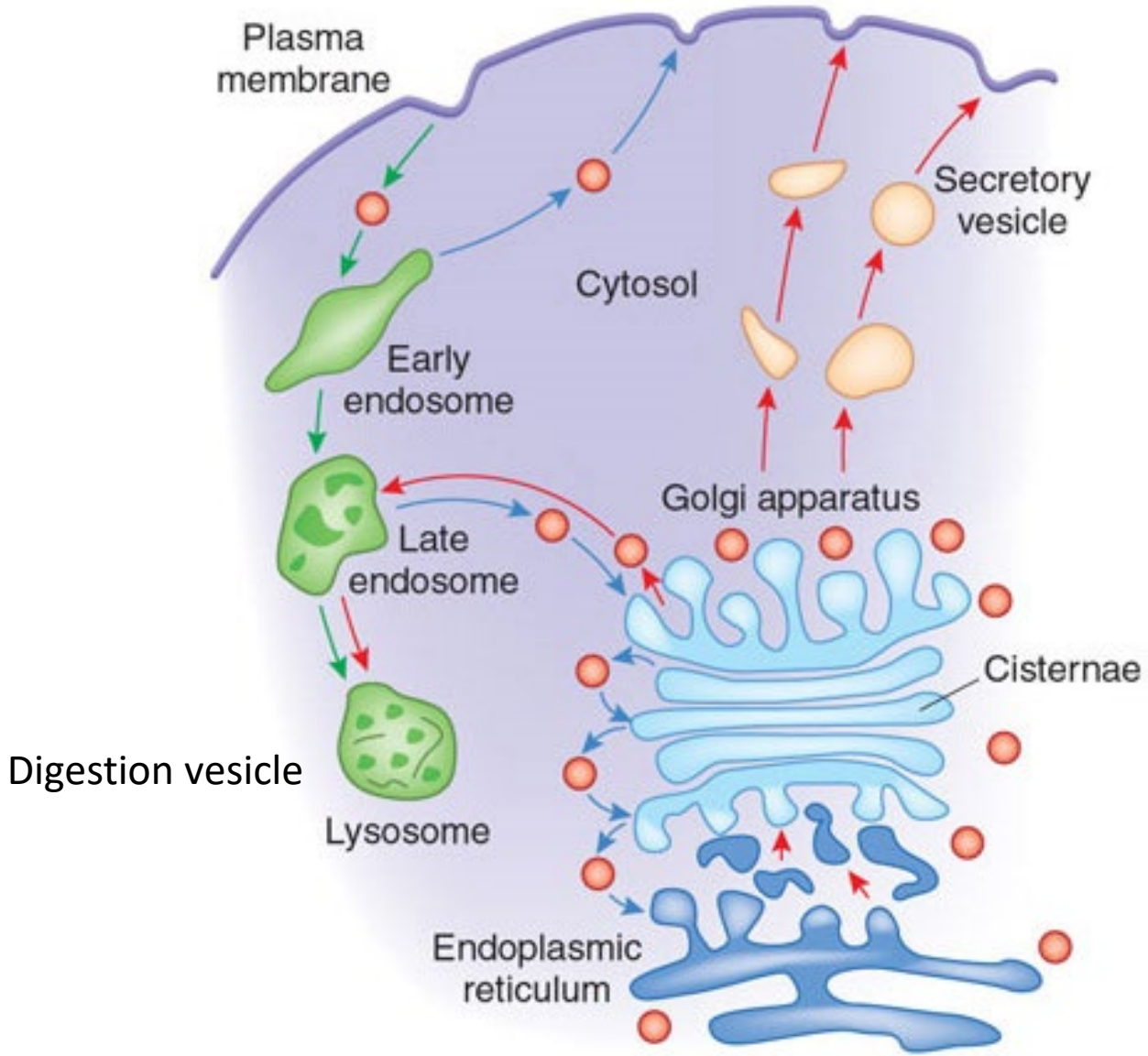




Addiction makes more sER

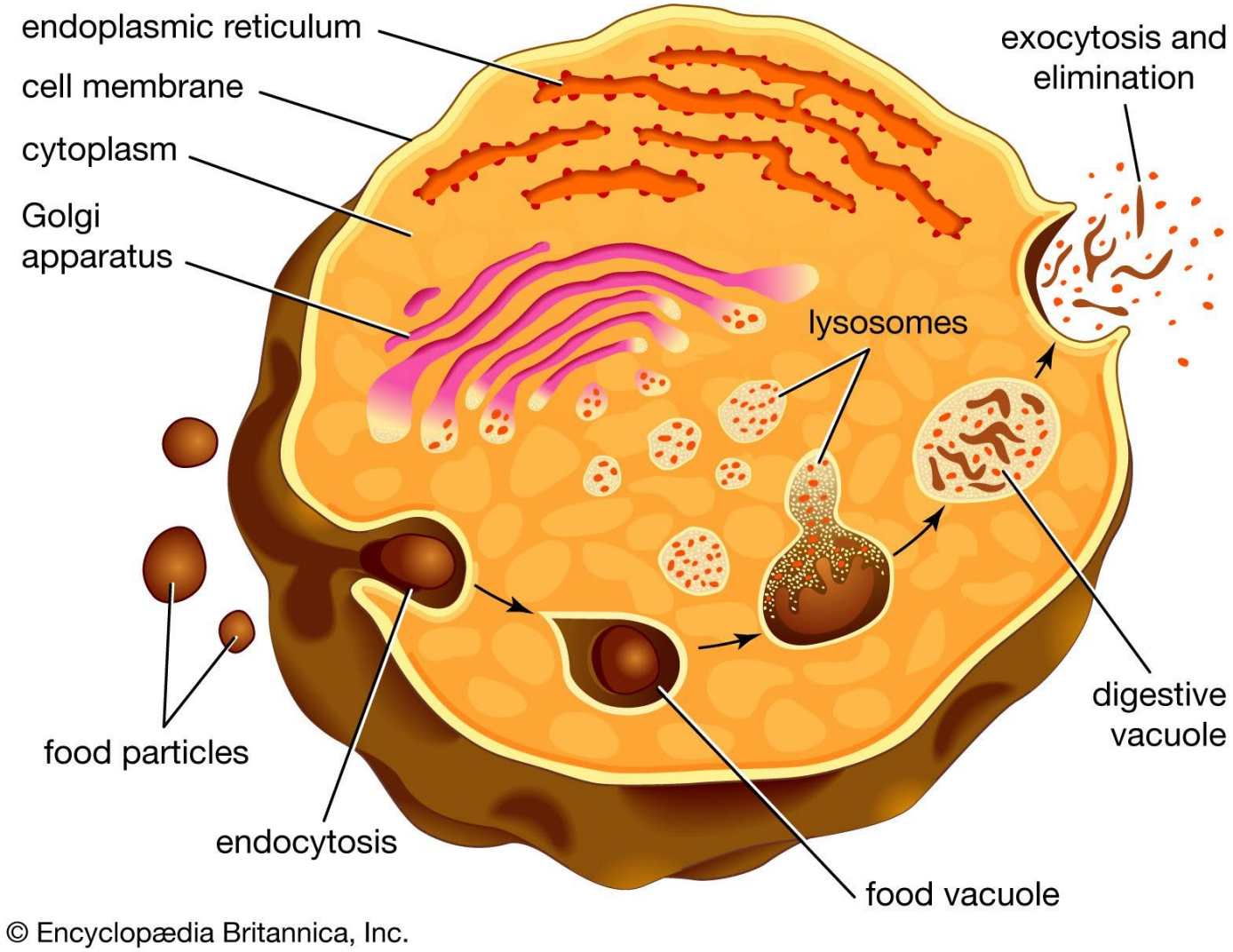
Post Office: Golgi Apparatus

Proteins made in the rER are sent to Golgi to be packaged in vesicles. Can then be secreted from cell , or used to digest, or used for other organelles.



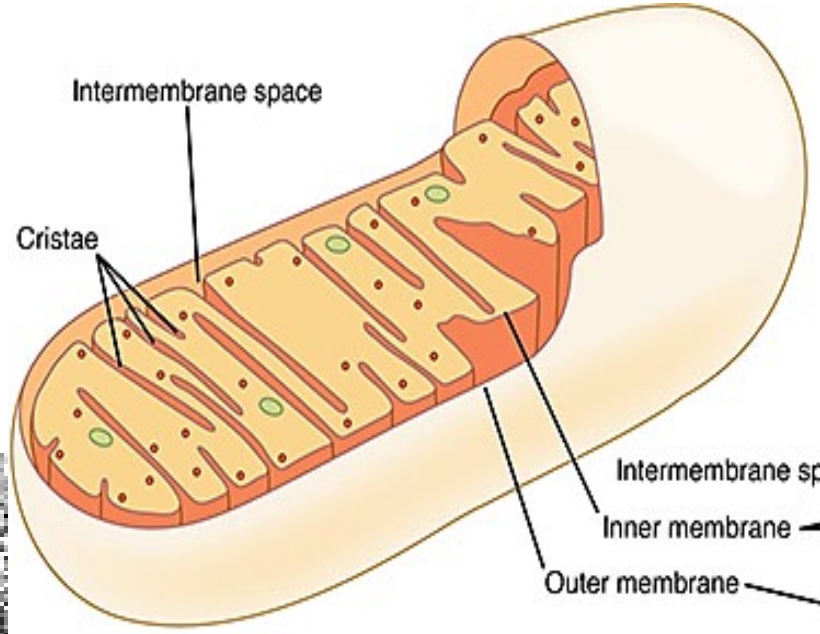
Garbage Disposal: Lysosomes

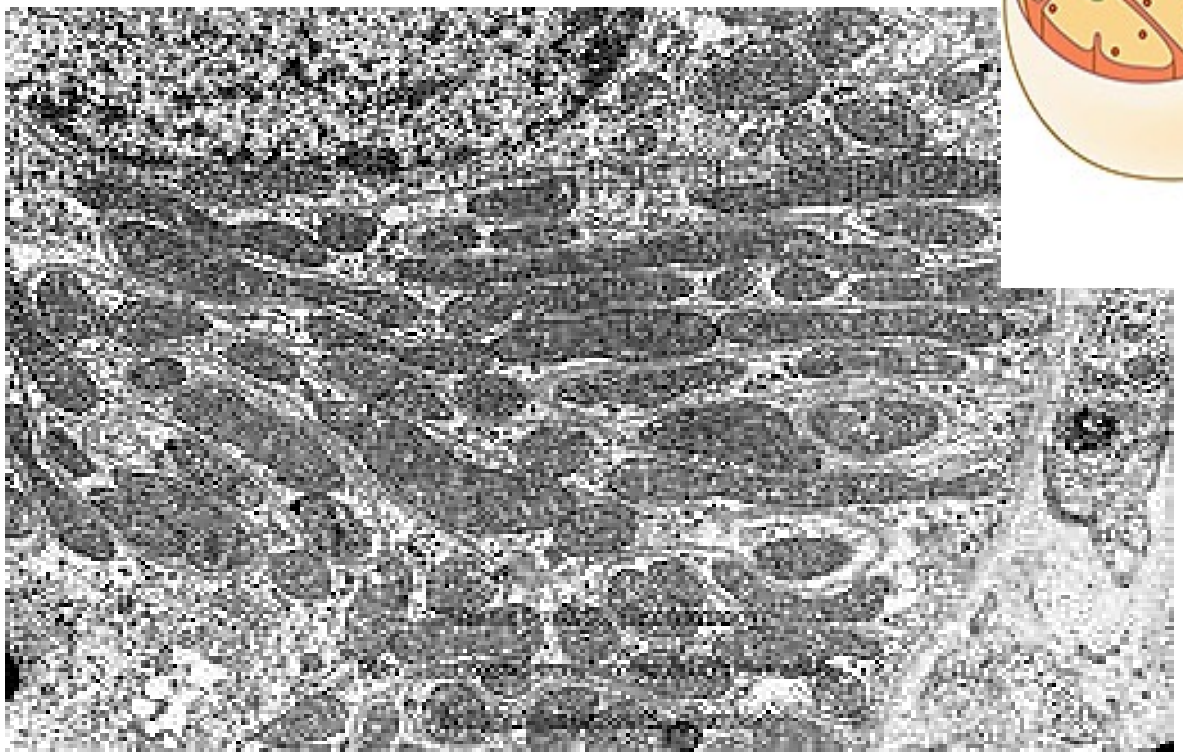
Vesicles filled with strong acid and digestive proteins that digest food or old organelles.



Power Plants: Mitochondria

Uses oxygen and food to generate **ATP**, the energy currency of life.

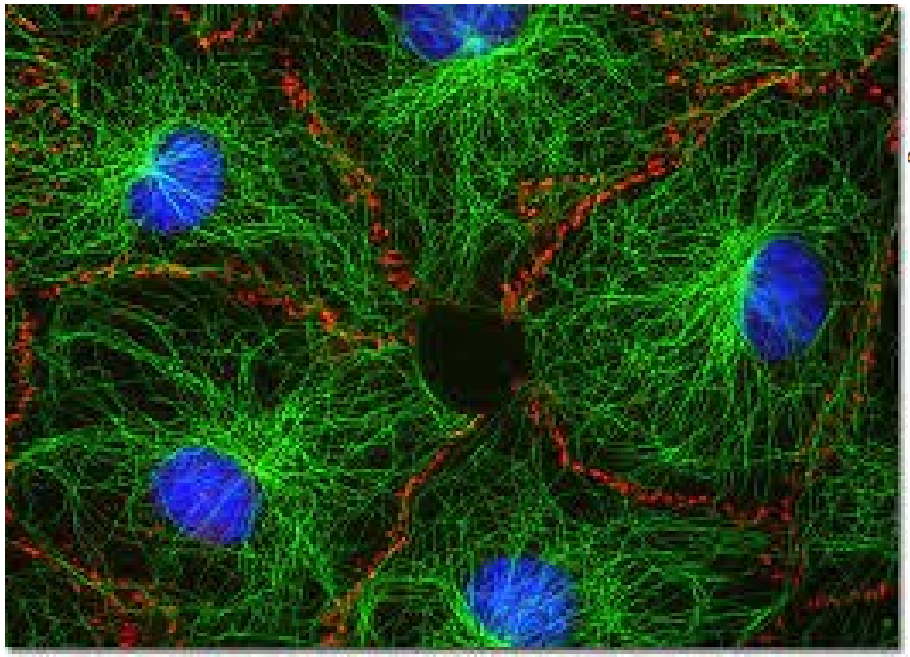


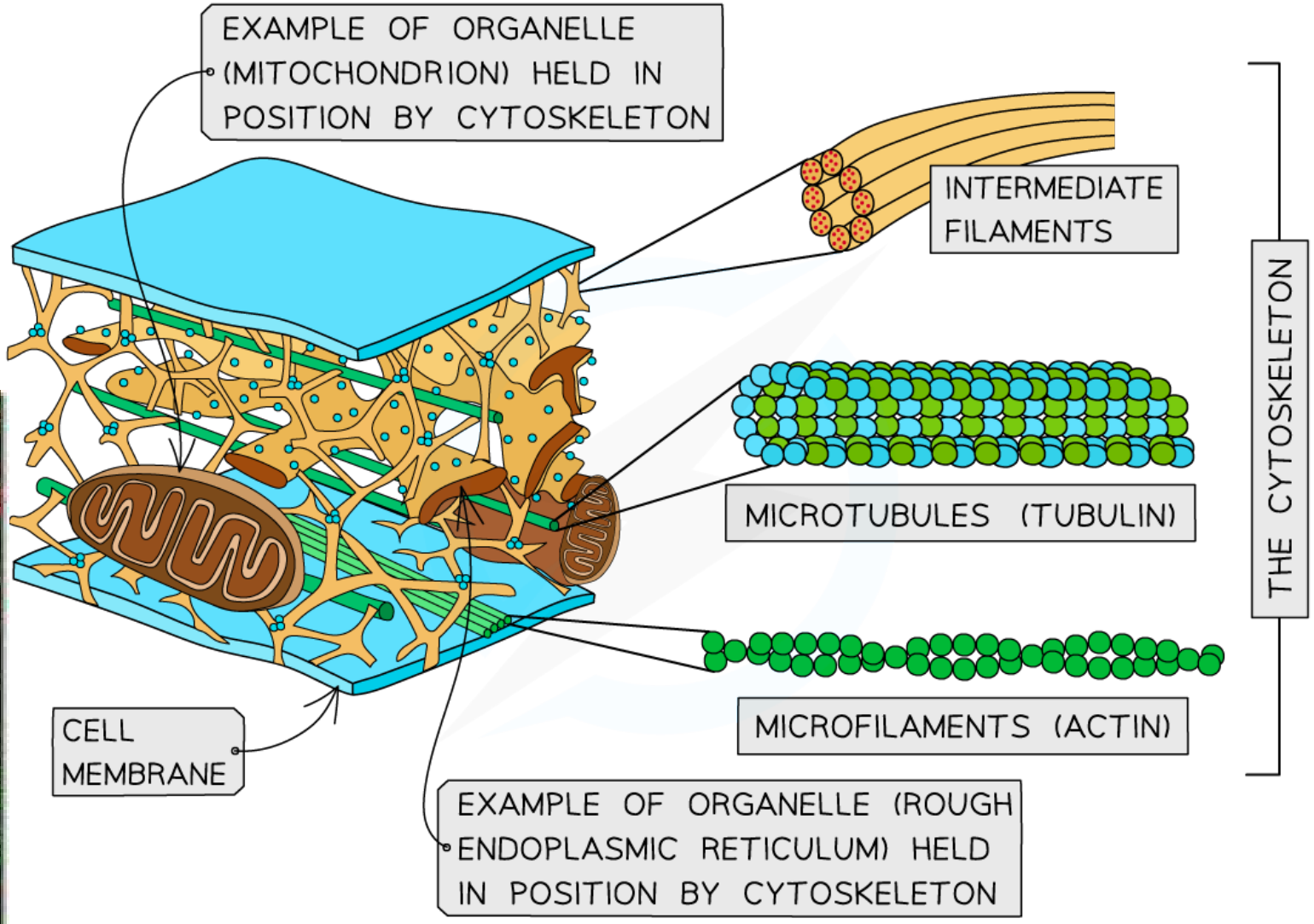


Kidney cell with lots!

Roads: Cytoskeleton

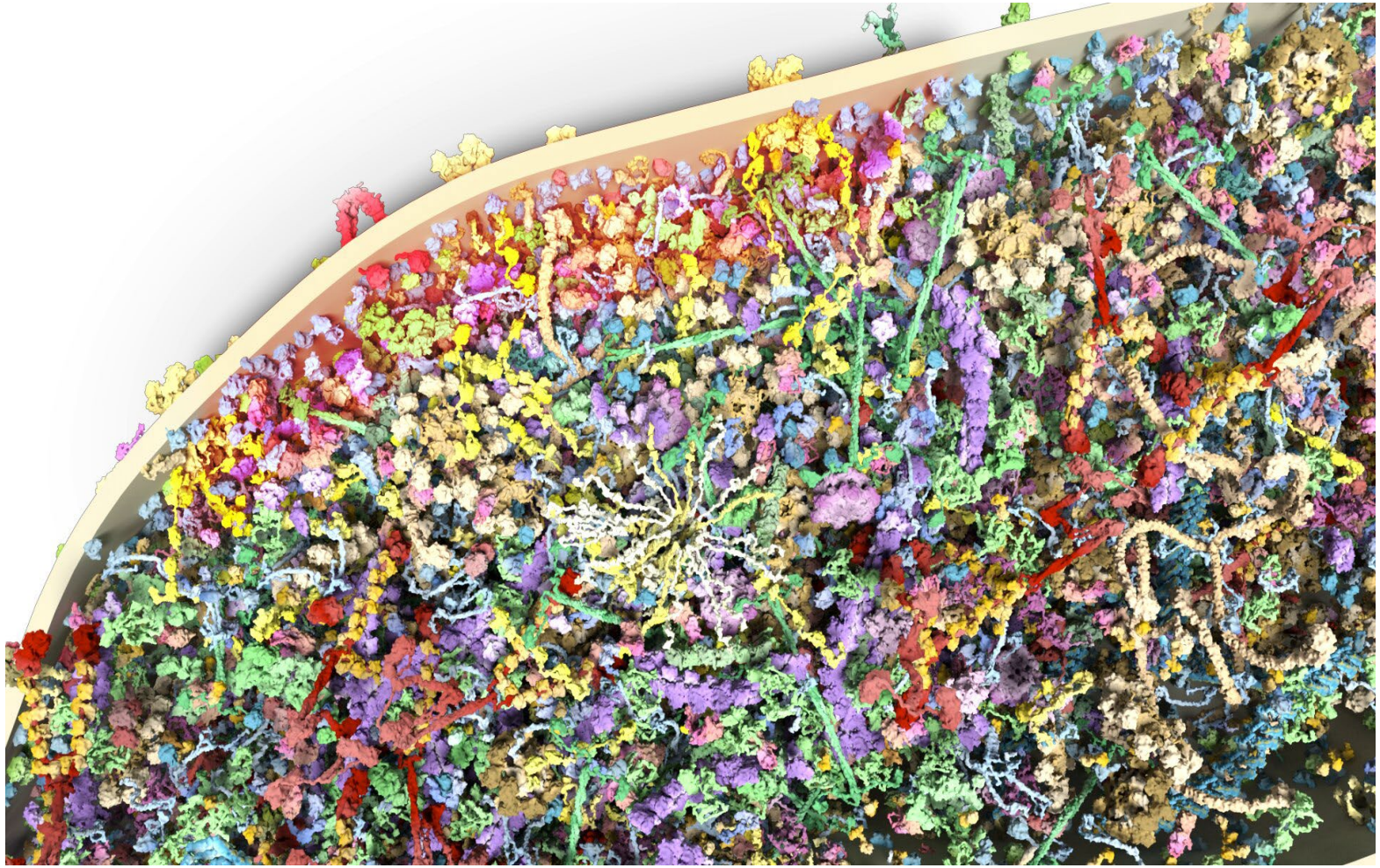
Generate cell movement, support the shape, hold organelles in place, move organelles within the cell.

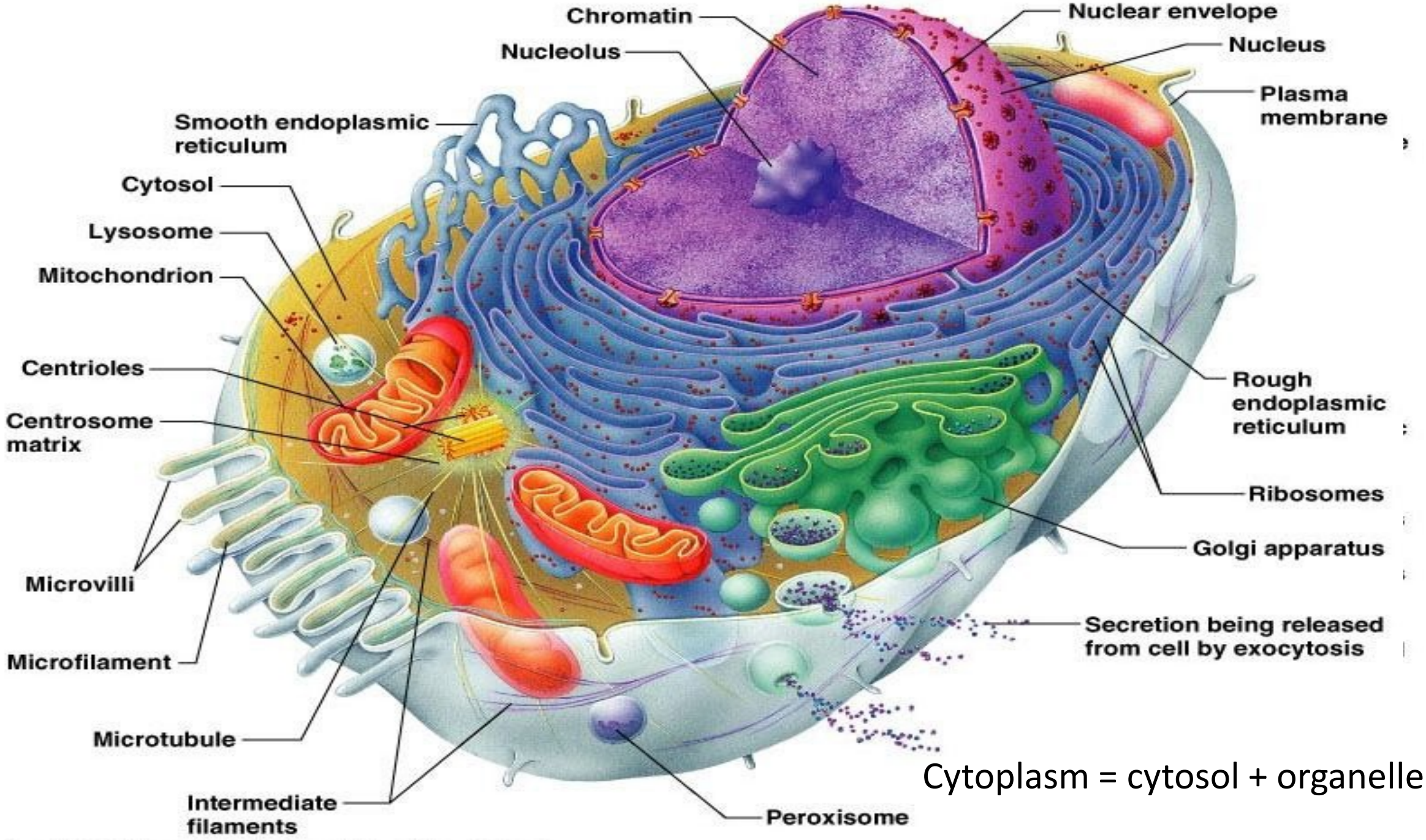




Cytosol

Cytoplasm – organelles = cytosol. Highly concentrated gel. Figure is a model of size and concentration of proteins in a neuronal cytosol. Molecules in constant motion, bumping into each other and interacting.





Cytoplasm = cytosol + organelles