CELL THEORY

I. Development of the cell theory
   A. Hooke: mid 1665, discovered cells while examining cork under an early microscope
   B. Schleiden: 1838, all plants made of cells
   C. Schwann: 1839, all animals made of cells
   D. Virchow: 1855, all cells come from existing cells

E. Three parts to the cell theory based on their work:

1. All living things are made up of cells

2. Cells are the basic units of structure & function in living things

3. New cells are produced from existing cells, and inherit genetic material from parent cells

II. Basic cell types

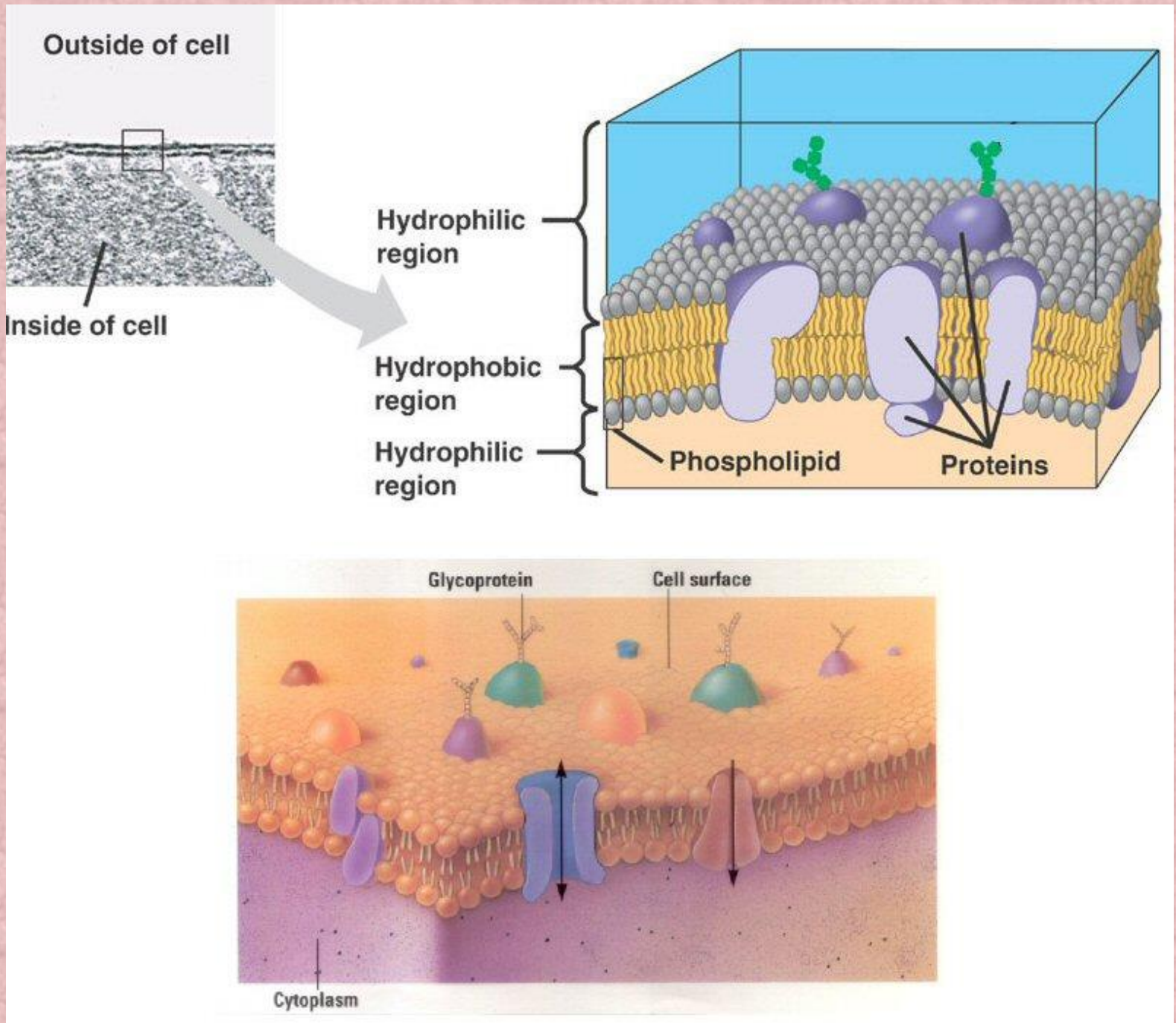
A. Prokaryotes: very simple cells, no true nucleus, e.g. bacteria

B. Eukaryotes: more complex cells, true nucleus, organelles, e.g. plant cells

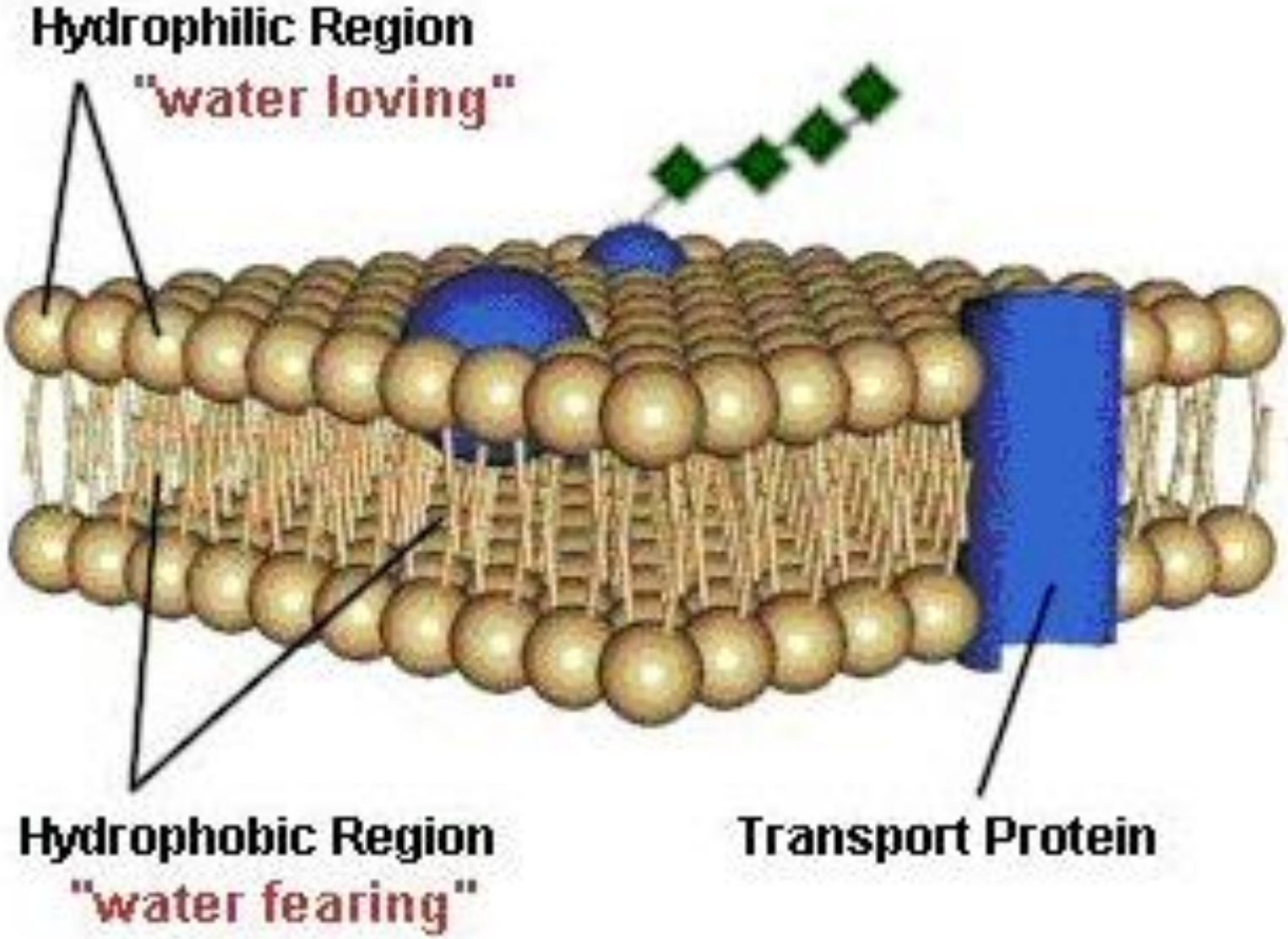
III. Cell structures and organelles

A. Cell membrane

1. Surrounds all cells
2. Semi-permeable: some materials can pass through, others cannot
3. Double lipid layer is polar, which prevents water-soluble materials from passing through
4. Proteins embedded in the membrane help transport some materials in and out


Outside of cell
Inside of cell
Hydrophilic region
Hydrophobic region
Hydrophilic region
Phospholipid
Proteins
Glycoprotein
Cell surface
Cytoplasm

Cell Membrane



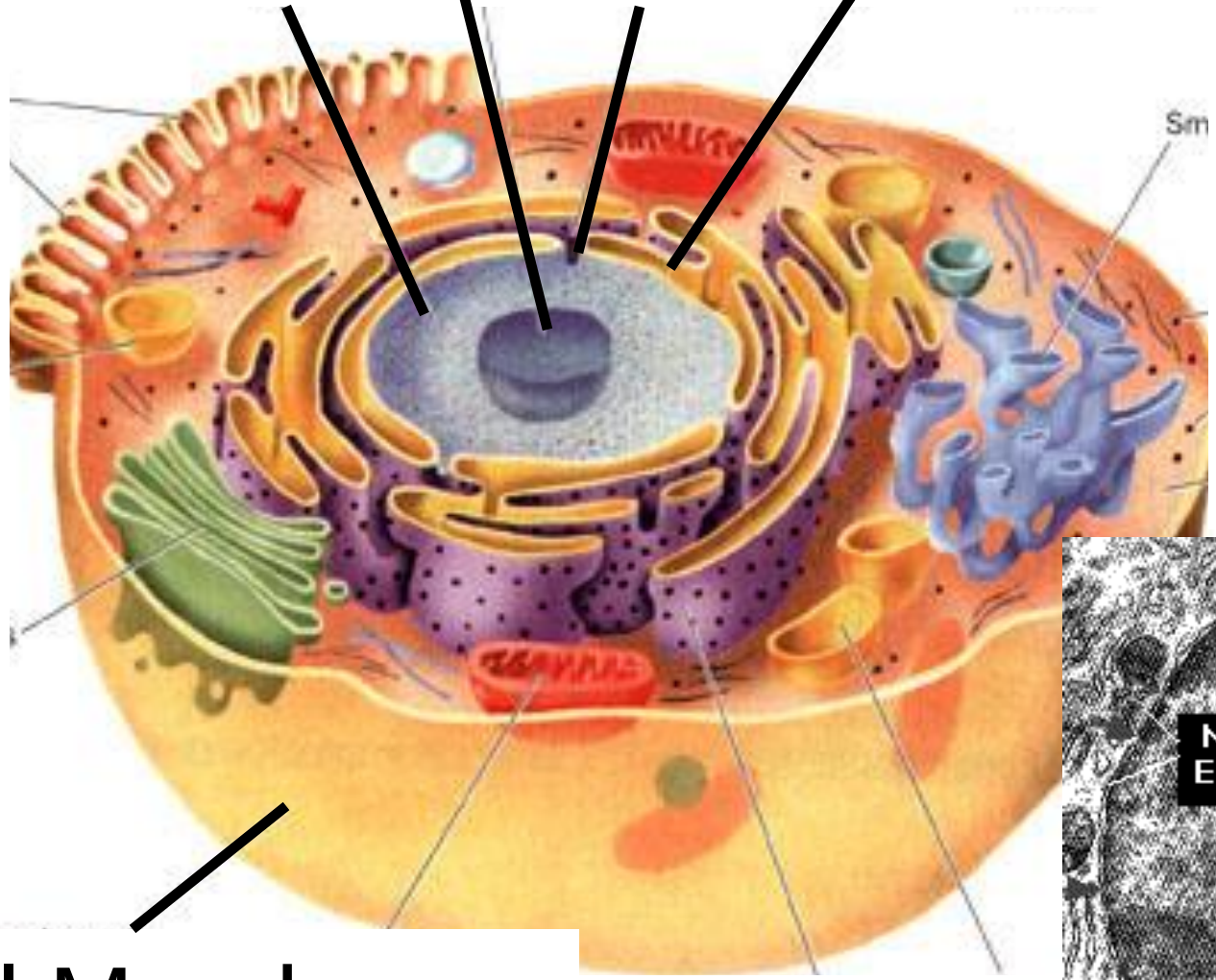
B. Nucleus
   1. Controls activities in the cell by controlling protein synthesis
   2. Nucleoli: round structure inside nucleus involved in making ribosomes
   3. Chromosomes: rod-shaped DNA, bundled for cell division
   4. Chromatin: long thin strands of DNA, open for copying, makes inside of nucleus look grainy

Nucleus:

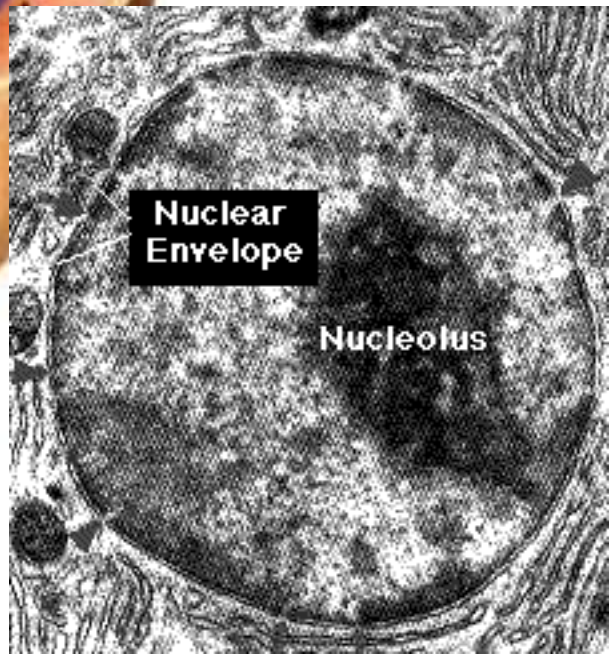
Chromatin

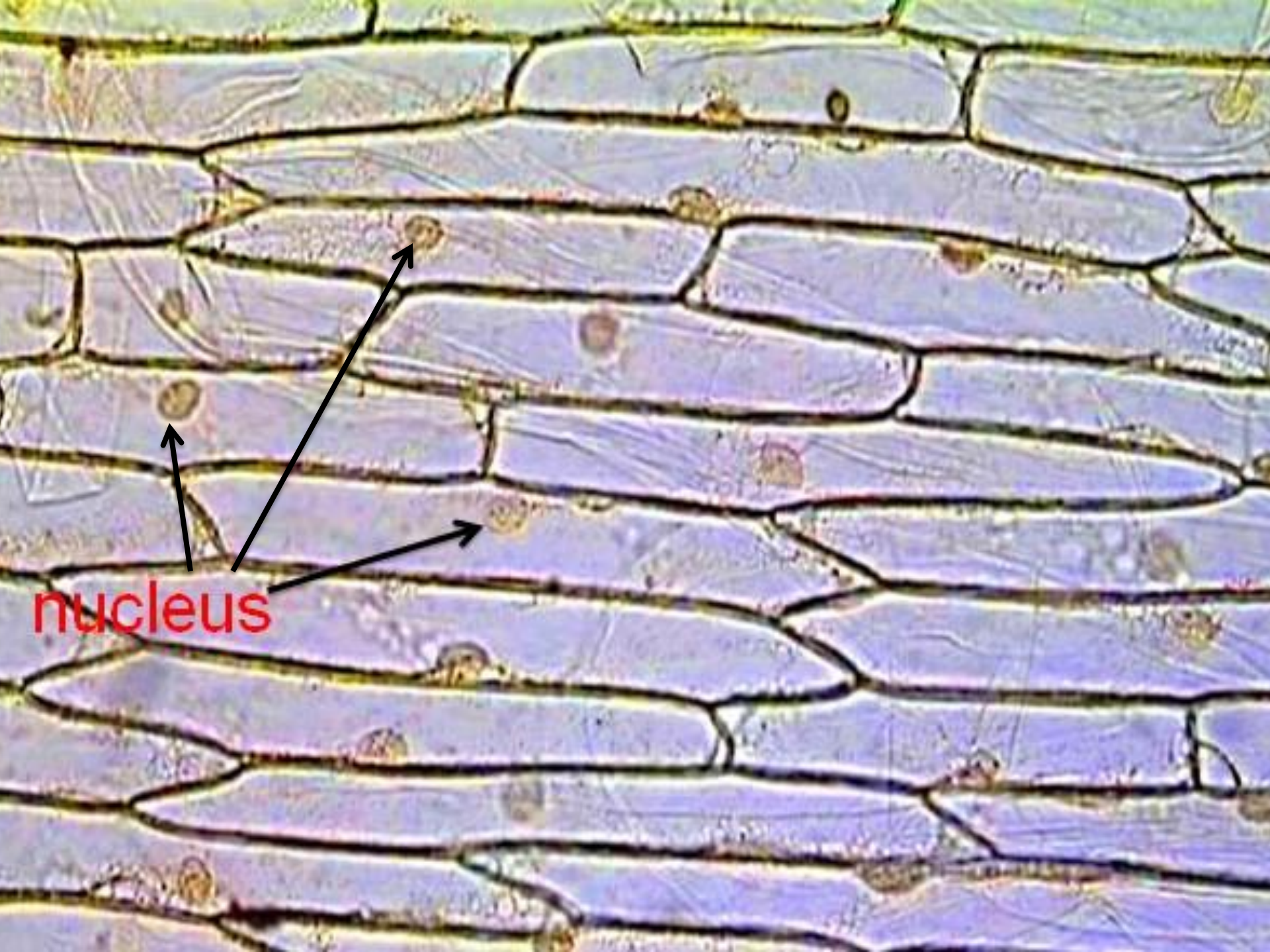
Nucleolus

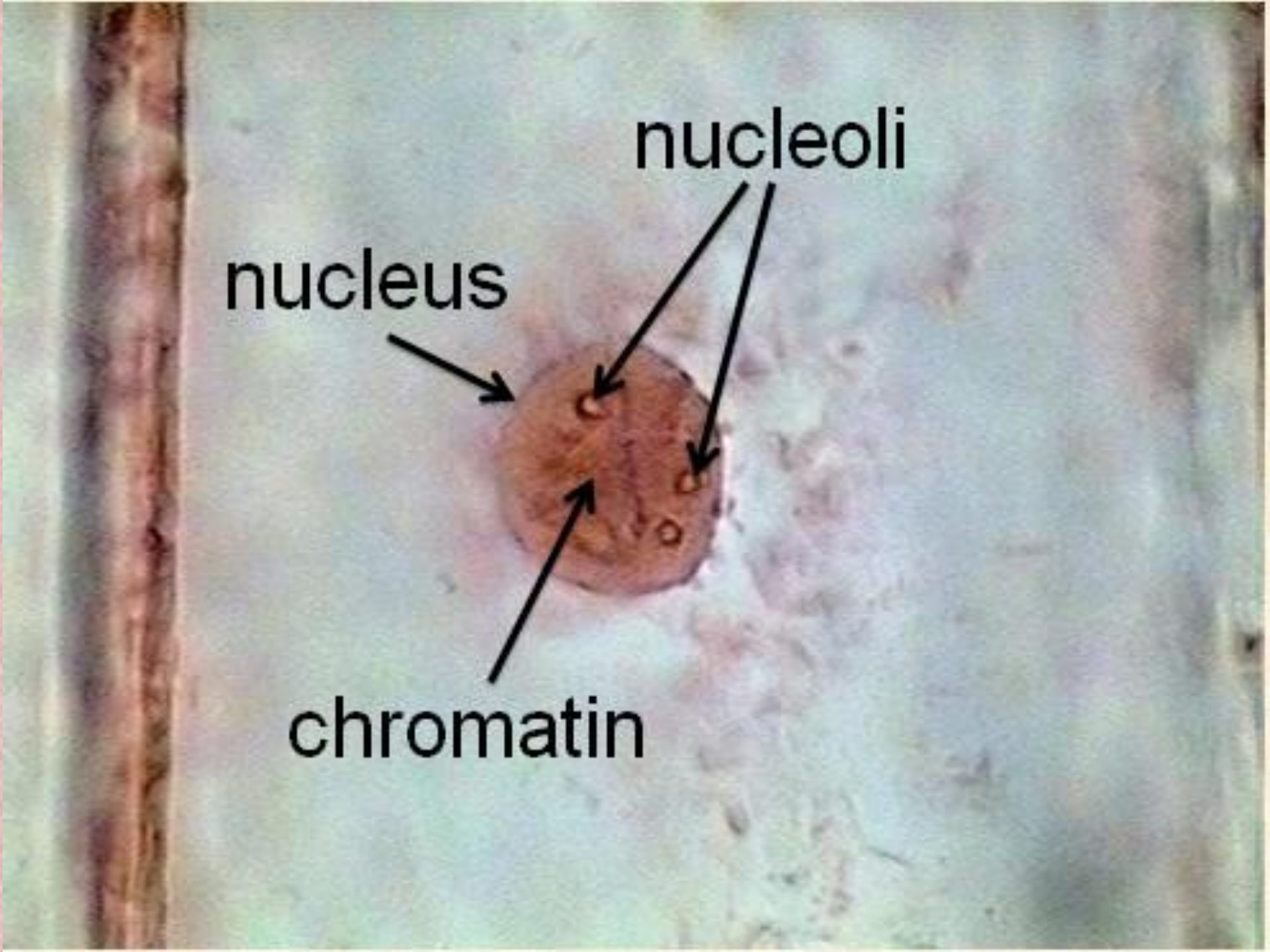
Nuclear envelope



Cell Membrane

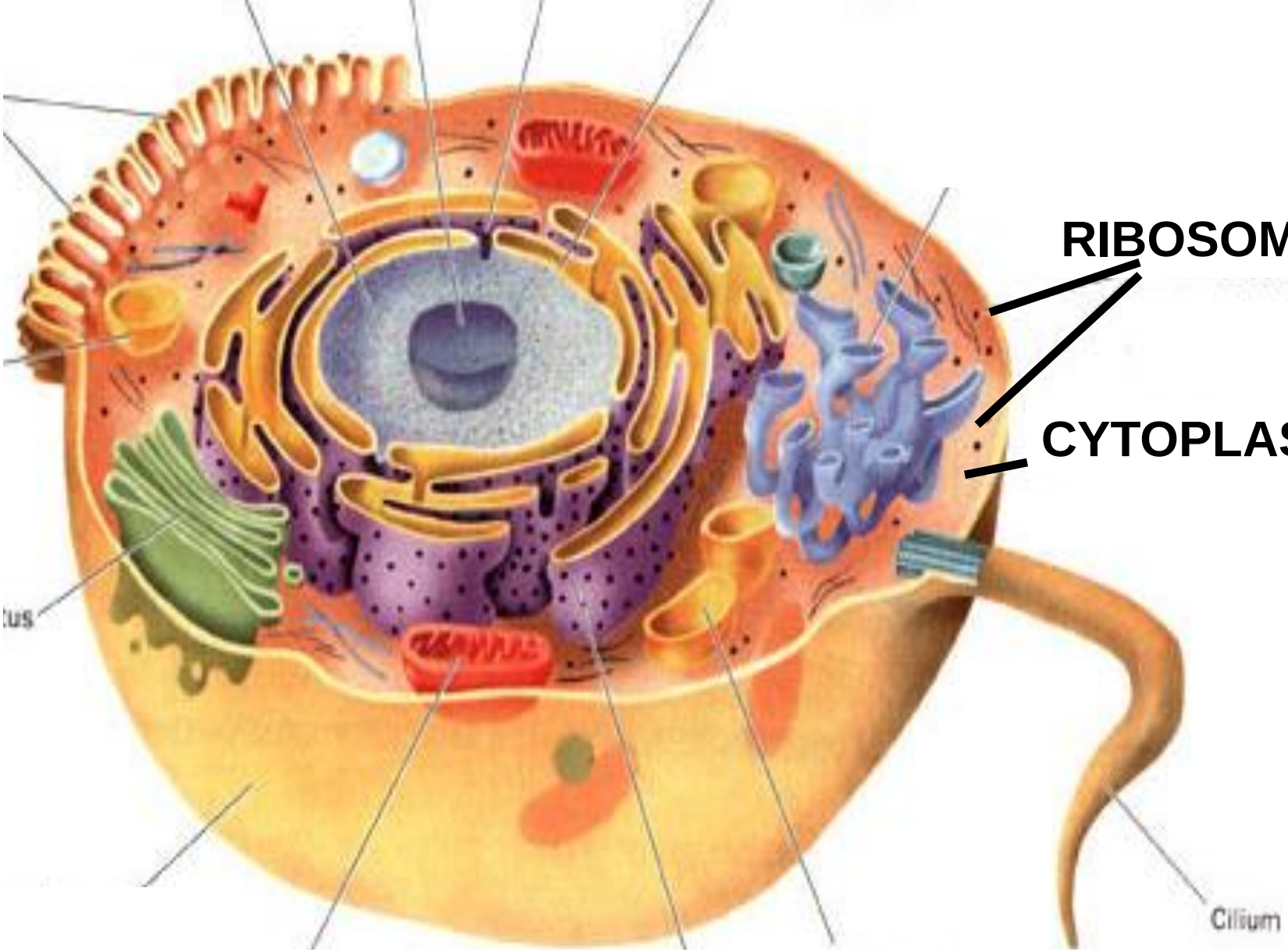



nucleus

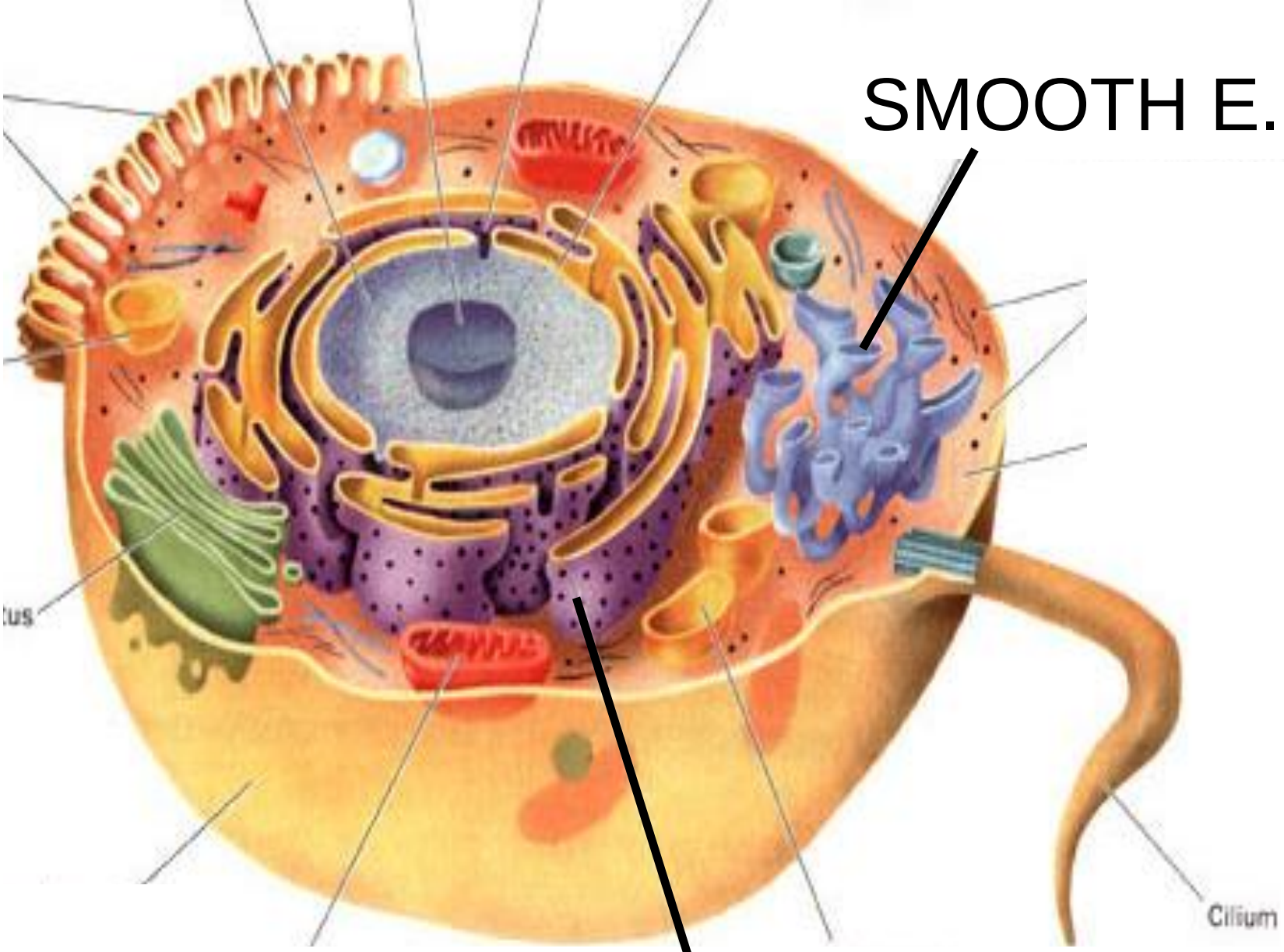

nucleoli
nucleus
chromatin

C. Cytoplasm
   1. Watery material that fills up the cell
   2. Site of many chemical reactions

D. Ribosomes
   1. small knob-like structures that are involved in protein synthesis

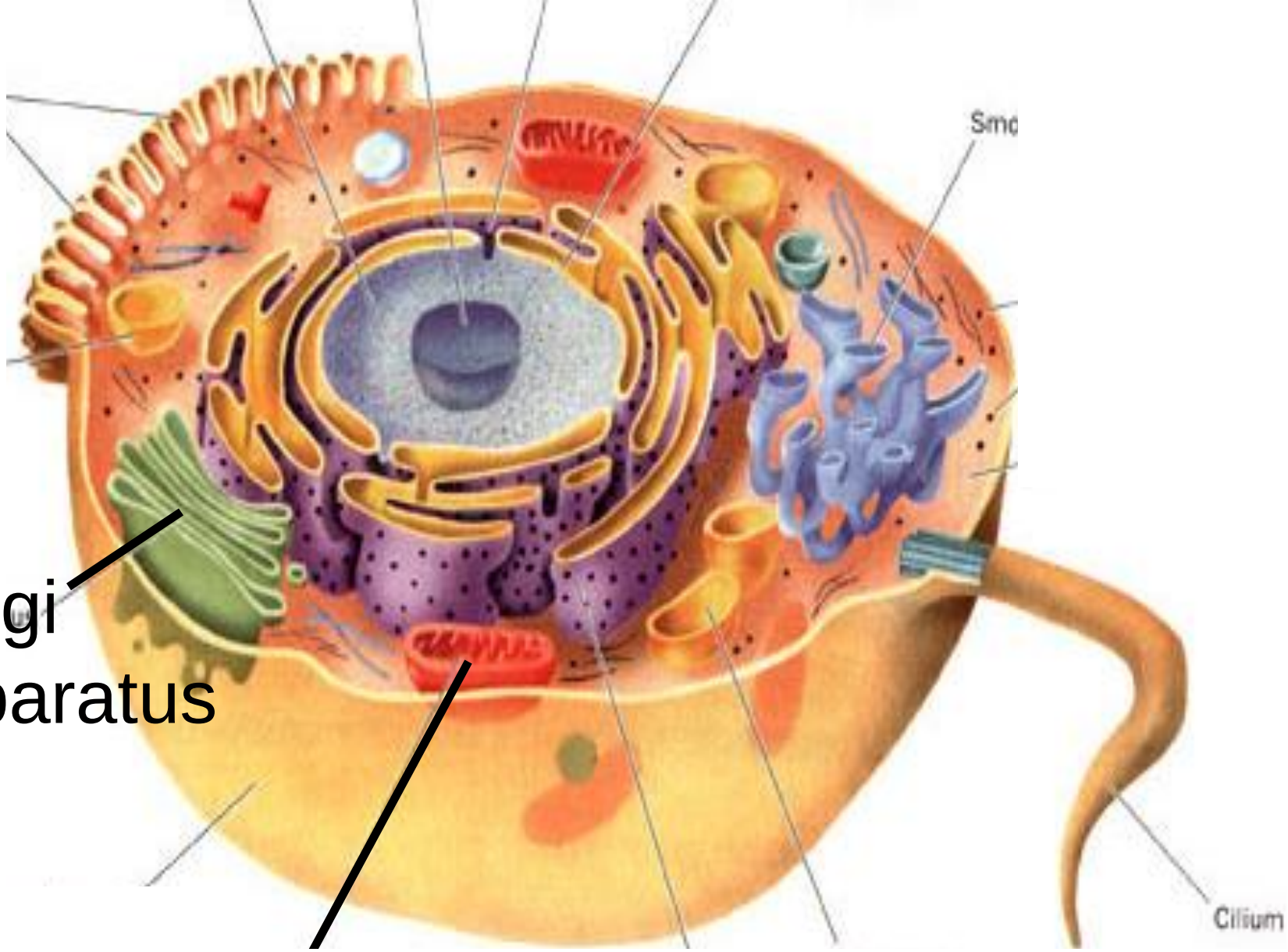

RIBOSOMES
CYTOPLASM
Cilium

E. Endoplasmic reticulum
   1. system of internal membranes
   2. site for protein and lipid synthesis
   3. Rough E.R.: have ribosomes attached on the outer surface

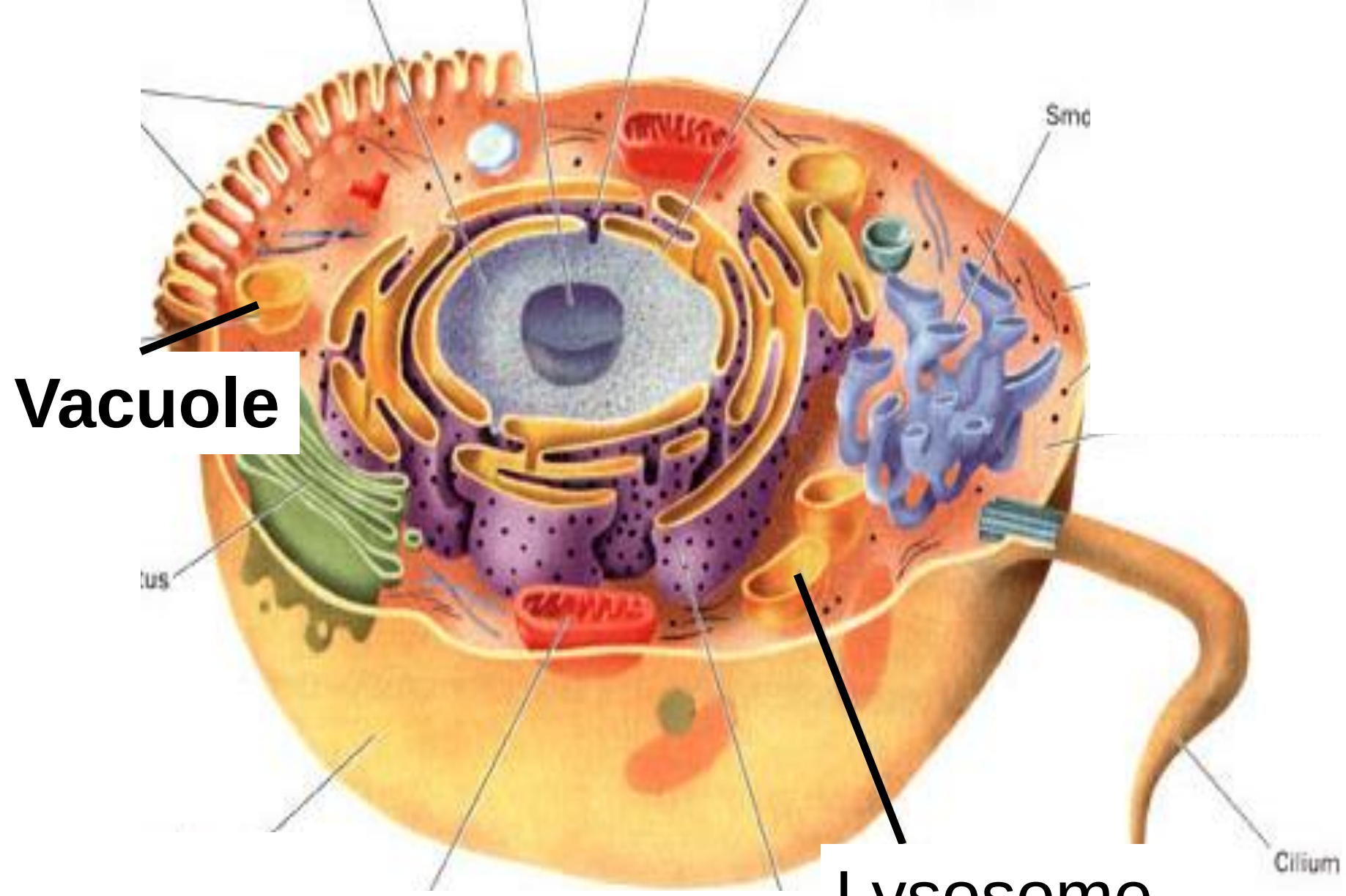

SMOOTH E.R.
Cilium
Rough E.R.

F. Golgi apparatus
   1. Stacks of flattened membranes
   2. Modifies, sorts, and packages proteins into vesicles

G. Mitochondria
   1. site of cellular respiration (chemical reactions that release energy for the cell)
   2. also called the powerhouse of the cell

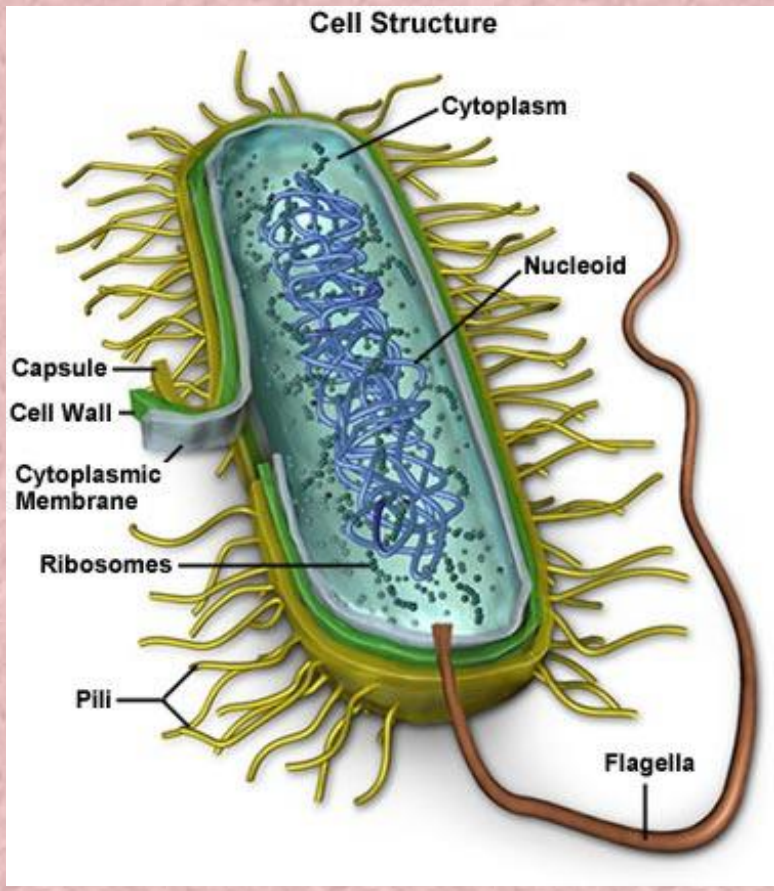

Golgi apparatus
Mitochondrion
Cilium

H. Lysosomes
    1. Contain digestive enzymes to break down old organelles and other large particles
I. Microtubules & microfilaments
    1. Provide shape & support for the cells and organelles
J. Vacuoles
    1. Storage sites for food, water, and waste materials


Vacuole
Lysosome
Cilium

K. Organelles found only in animal cells

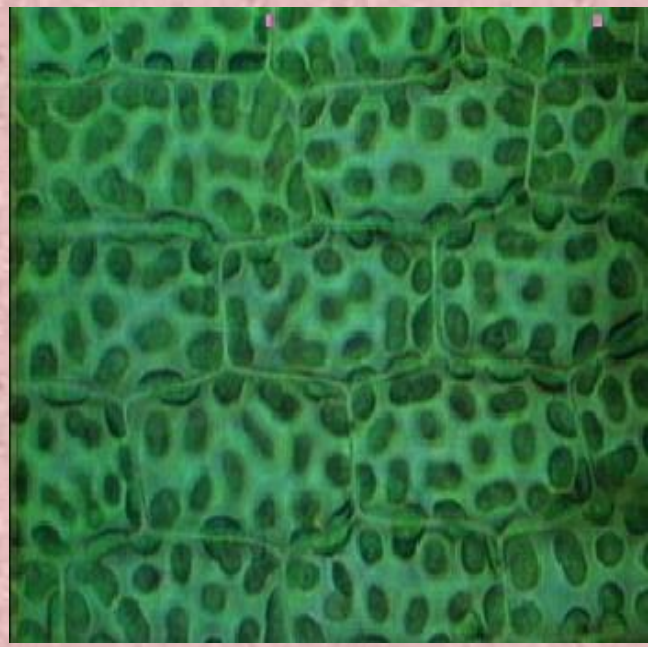
1. Centrioles: bundles of microtubules, involved in cell division
2. Flagella & cilia: on outside of cell, involved in movement

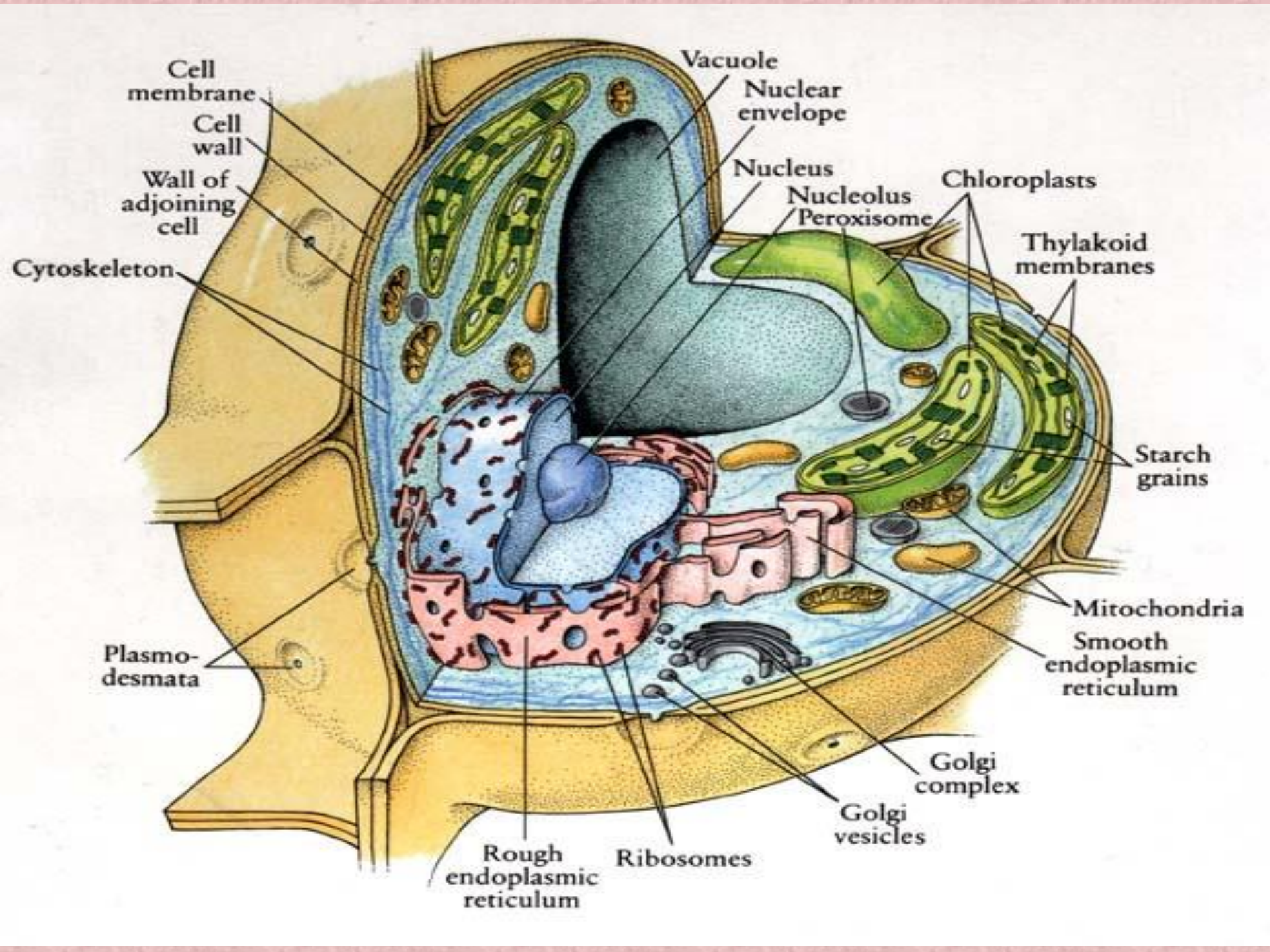


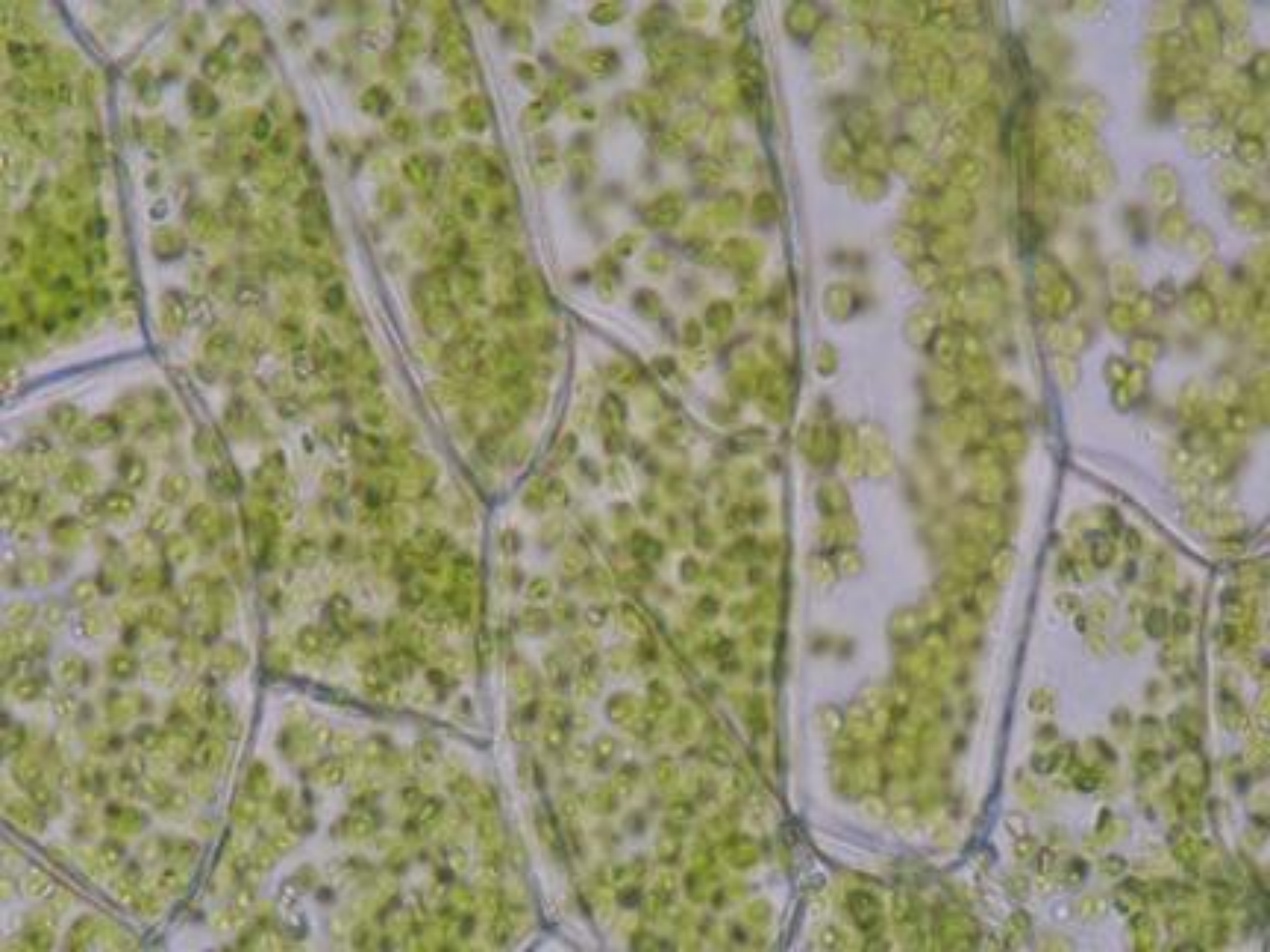
L.Organelles found only in plant cells

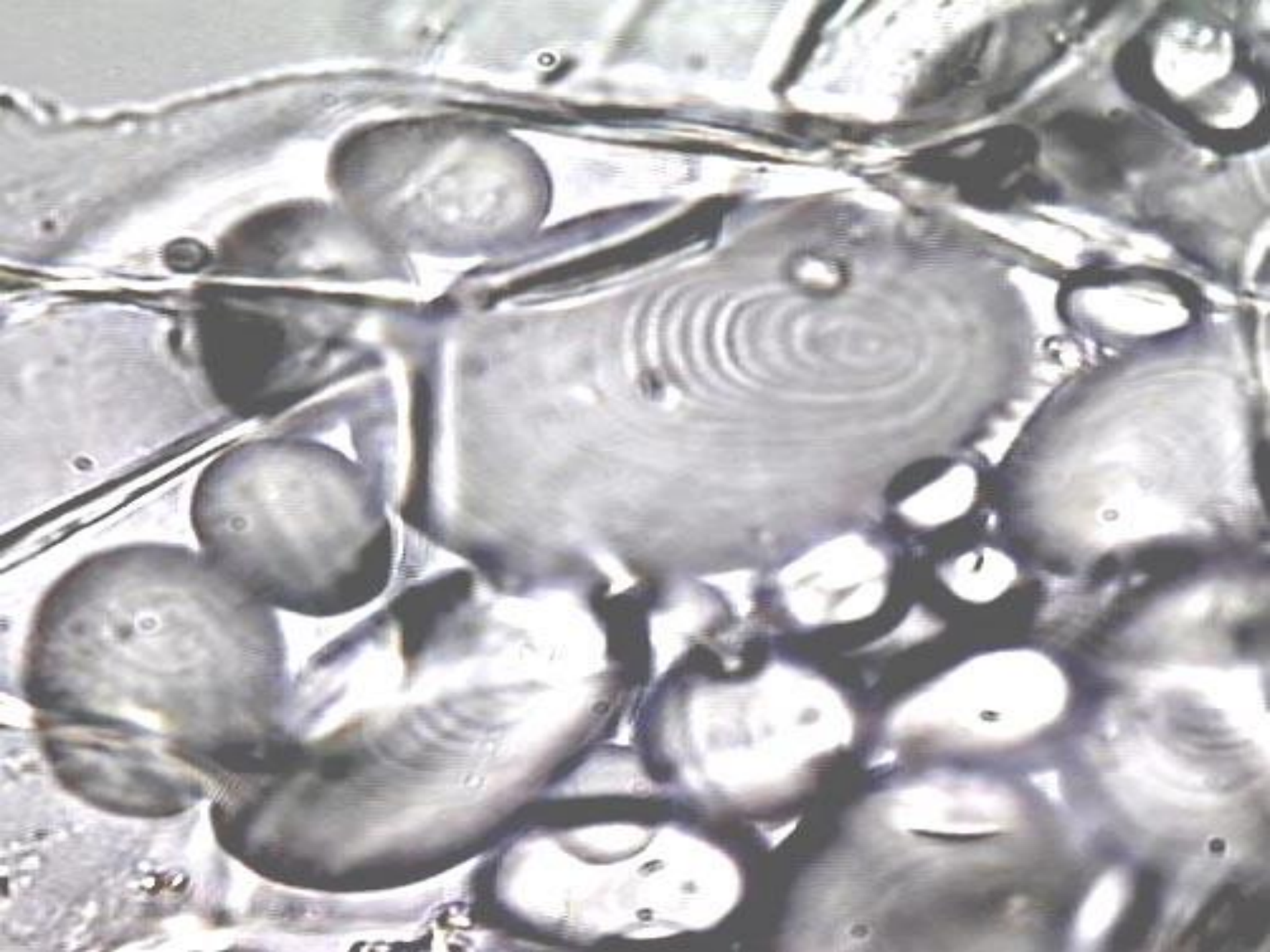
1. Cell Wall
   a) Surrounds plant cells
   b) Provides support & protection
   c) Made of cellulose

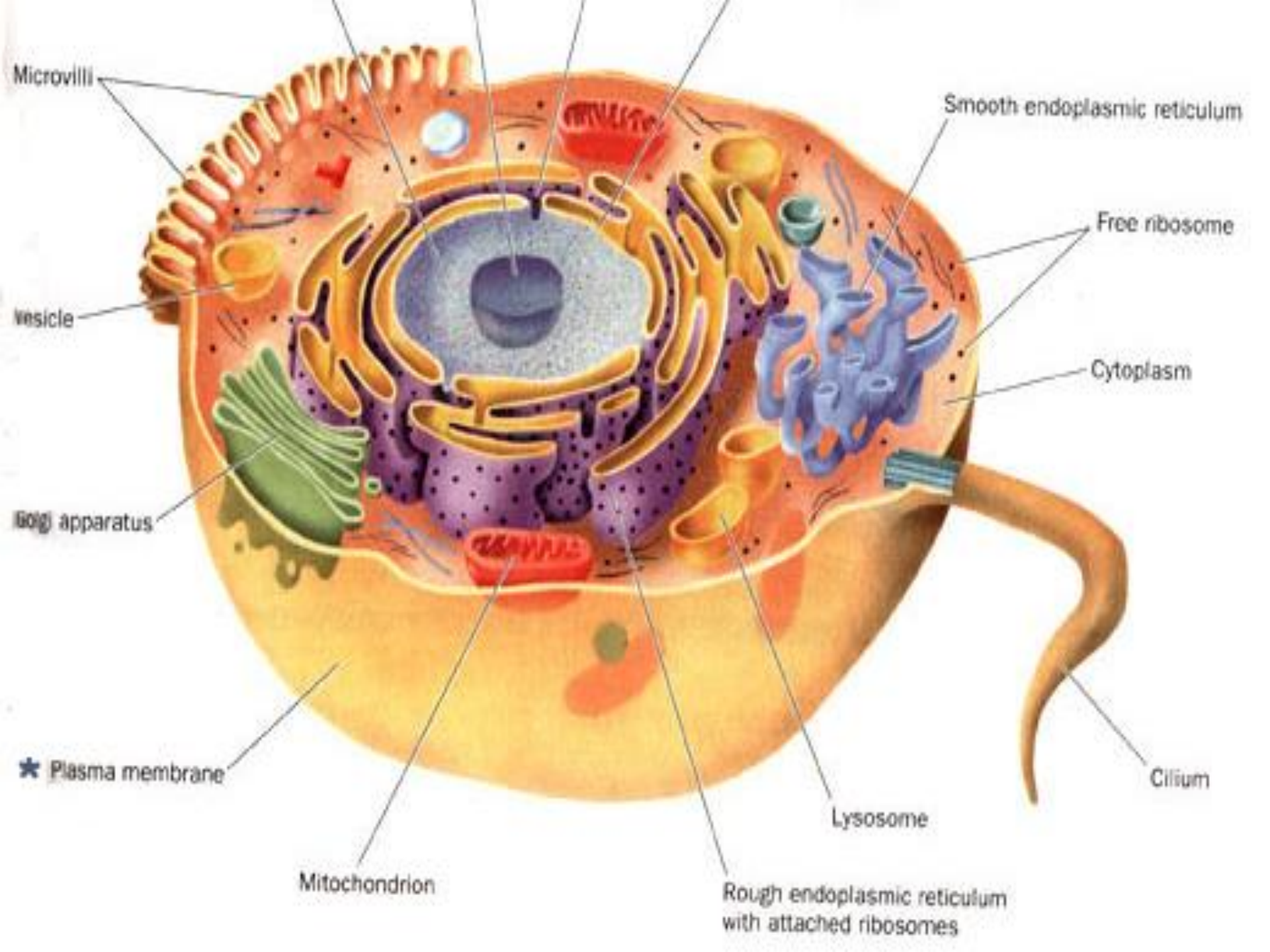
2. Plastids
   a) Leucoplasts store starch
   b) Chromoplasts contain red, yellow and orange pigments especially in leaves
   c) Chloroplasts contain chlorophyll, site of photosynthesis




Cell membrane
Cell wall
Wall of adjoining cell
Cytoskeleton
Plasmo-desmata
Vacuole
Nuclear envelope
Nucleus
Nucleolus
Peroxisome
Chloroplasts
Thylakoid membranes
Starch grains
Mitochondria
Smooth endoplasmic reticulum
Golgi complex
Golgi vesicles
Ribosomes
Rough endoplasmic reticulum





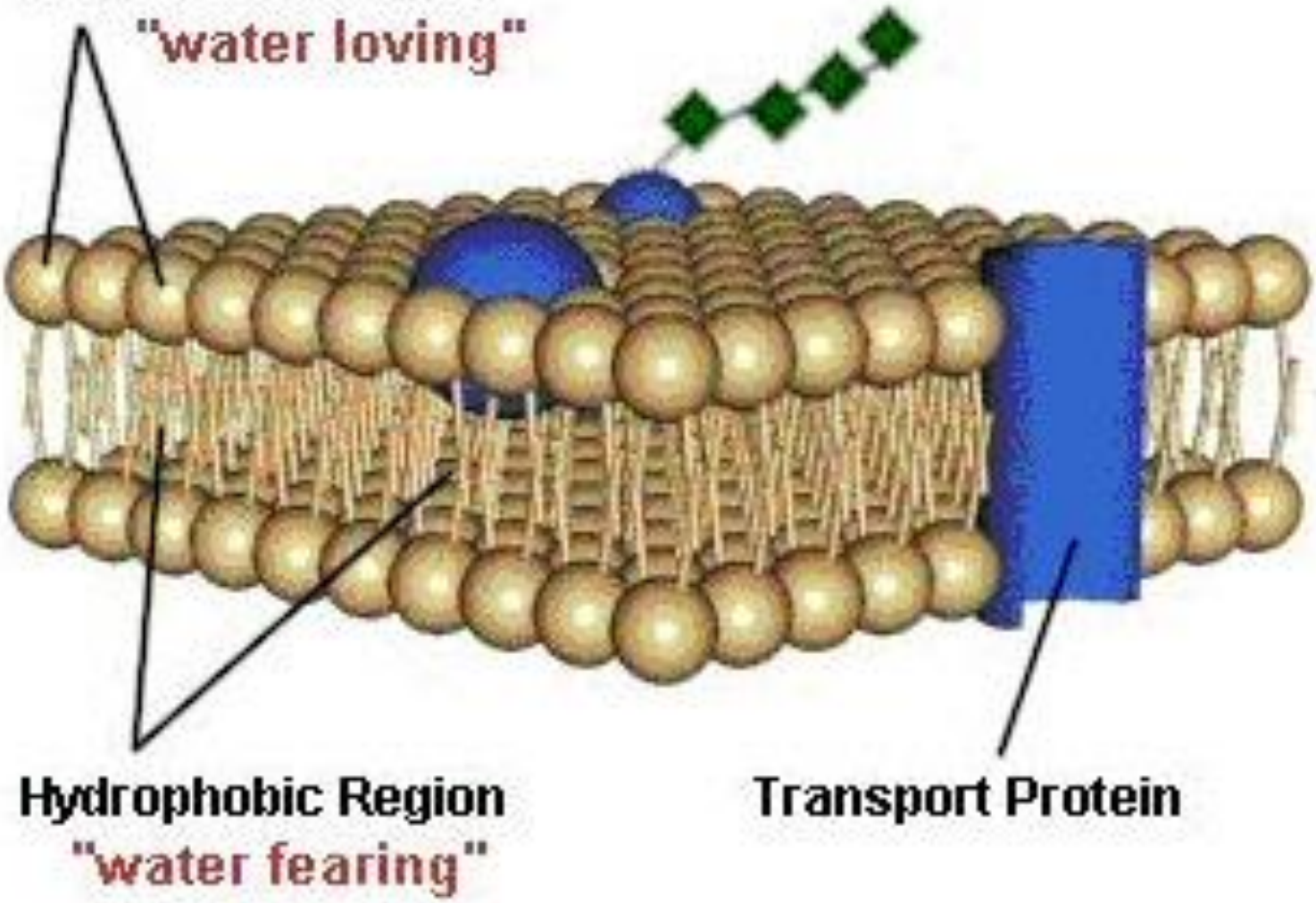

Microvilli
Smooth endoplasmic reticulum
Free ribosome
Vesicle
Cytoplasm
Golgi apparatus
* Plasma membrane
Cilium
Lysosome
Mitochondrion
Rough endoplasmic reticulum
with attached ribosomes

IV. Cell Transport

A. Selective permeability

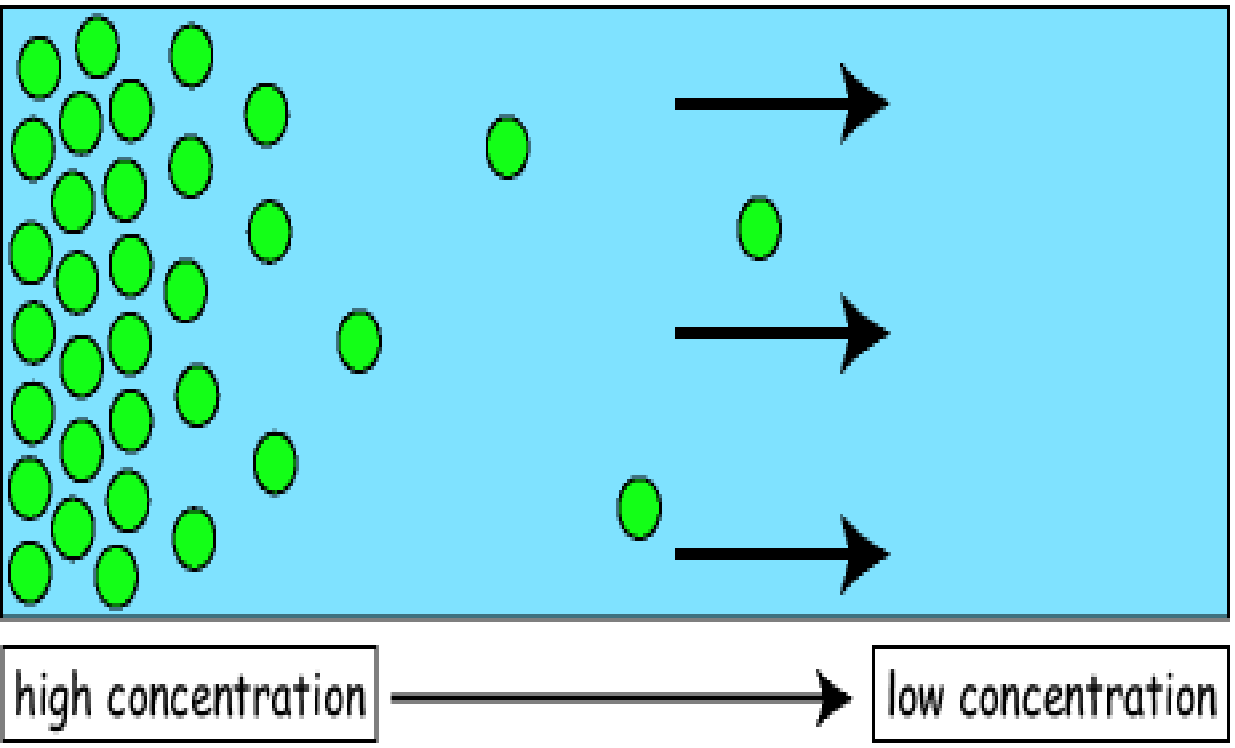
1. Cell membrane allows some molecules to pass through
2. Large molecules (eg starch) must be helped through
3. Oxygen, CO_2 & water can move freely through

Cell Membrane

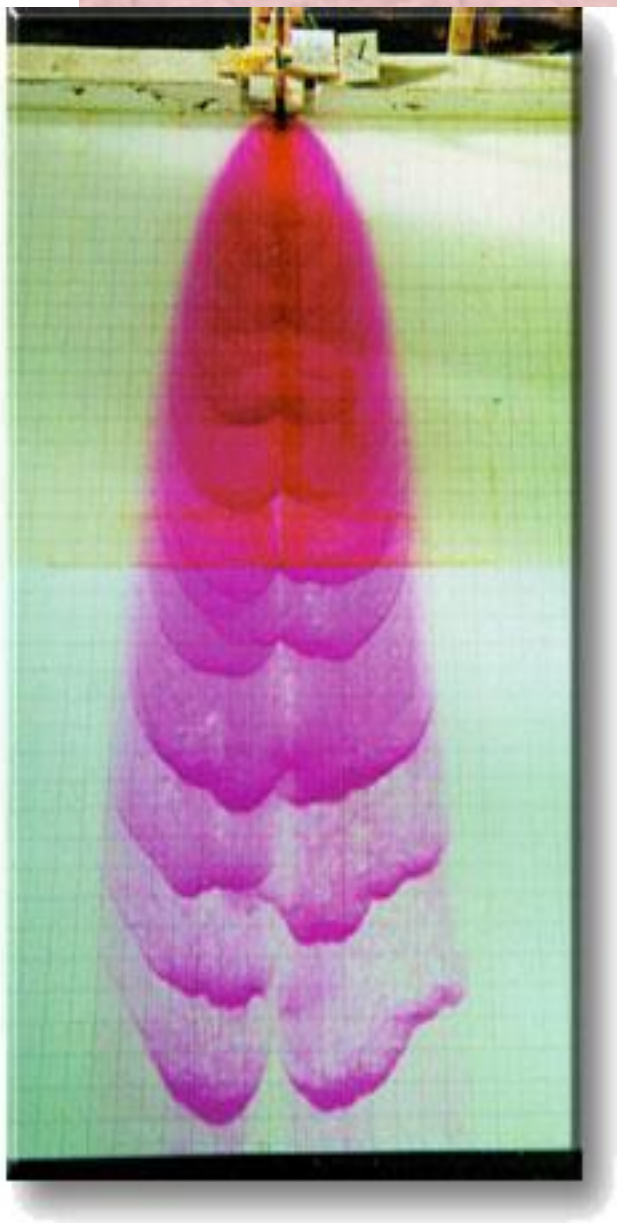


B. Passive Transport
   1. Does not require energy from the cell
   2. Diffusion: movement of molecules from an area of high concentration to an area of low concentration
      - Important for moving common materials in and out of cell (H_2O, CO_2, O_2)

Diffusion



● solute



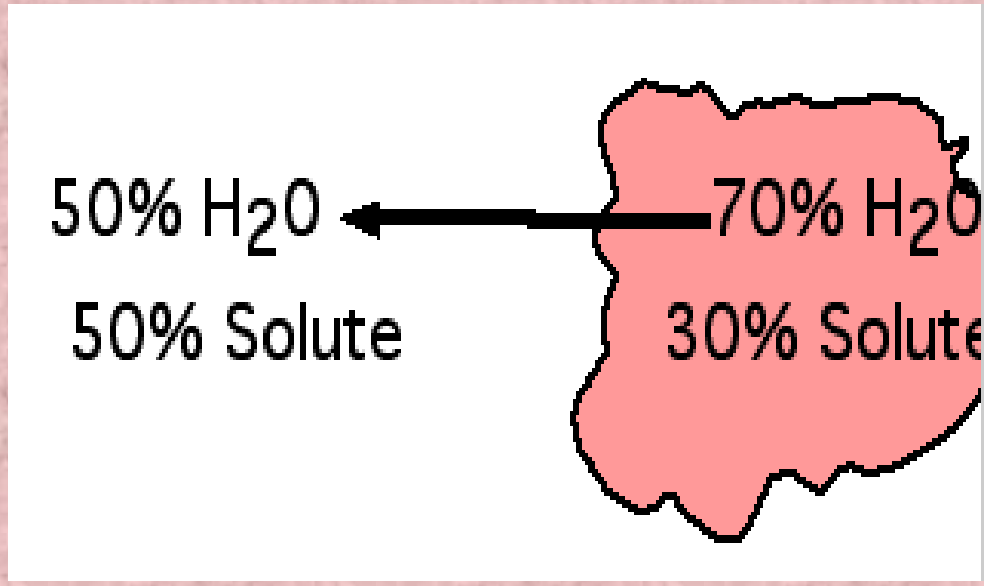
3. Osmosis
   a) Diffusion of H_2O across a membrane

   b) 3 possible situations:

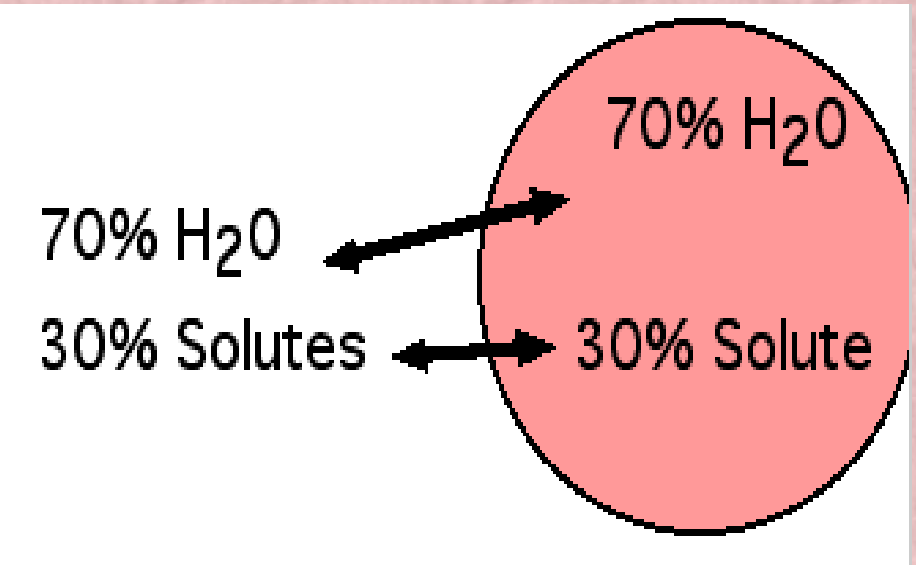
      1. **Isotonic solution**: same concentrations of water and solutes inside & out of cell

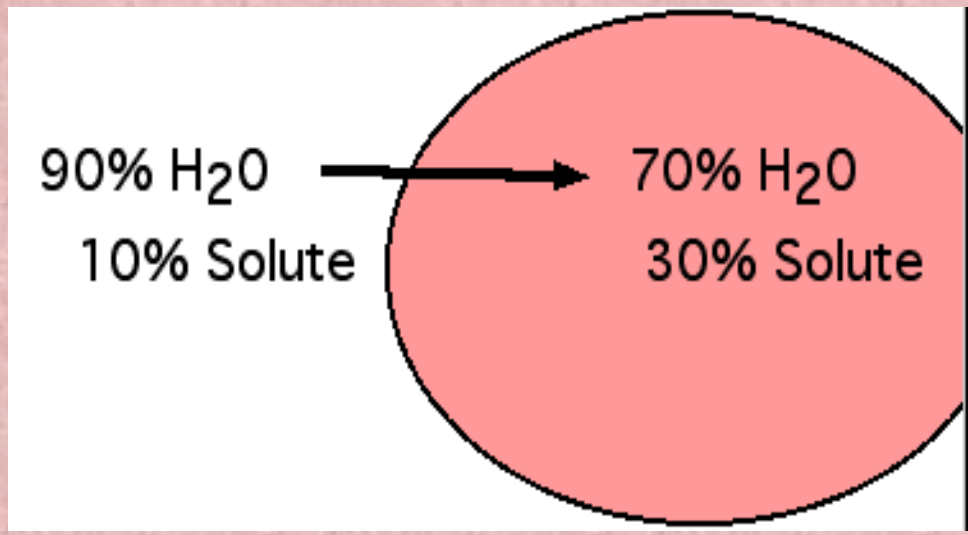
2. **Hypotonic**: lower conc. of solutes and a higher concentration of water outside the cell than inside
3. **Hypertonic**: higher conc. of solutes and a lower conc. Of water outside than inside

HYPERTONIC: cell shrivels

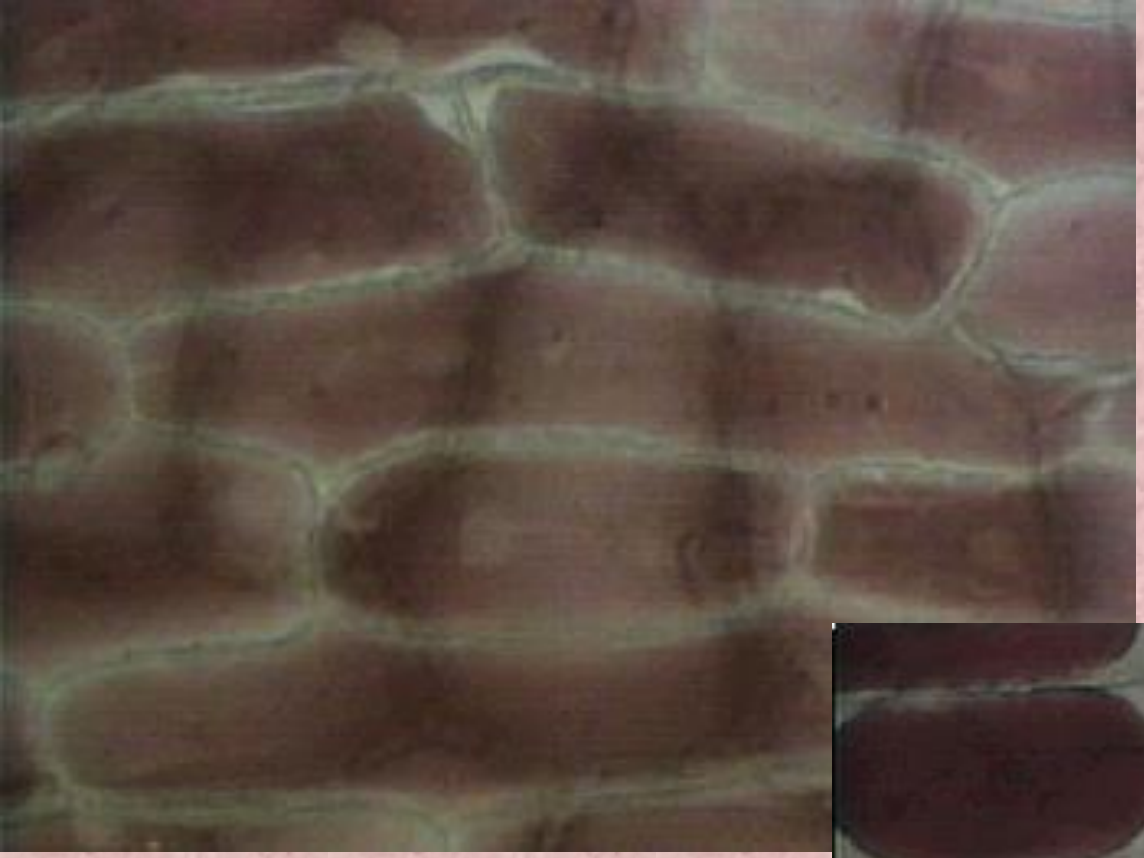


ISOTONIC: no change





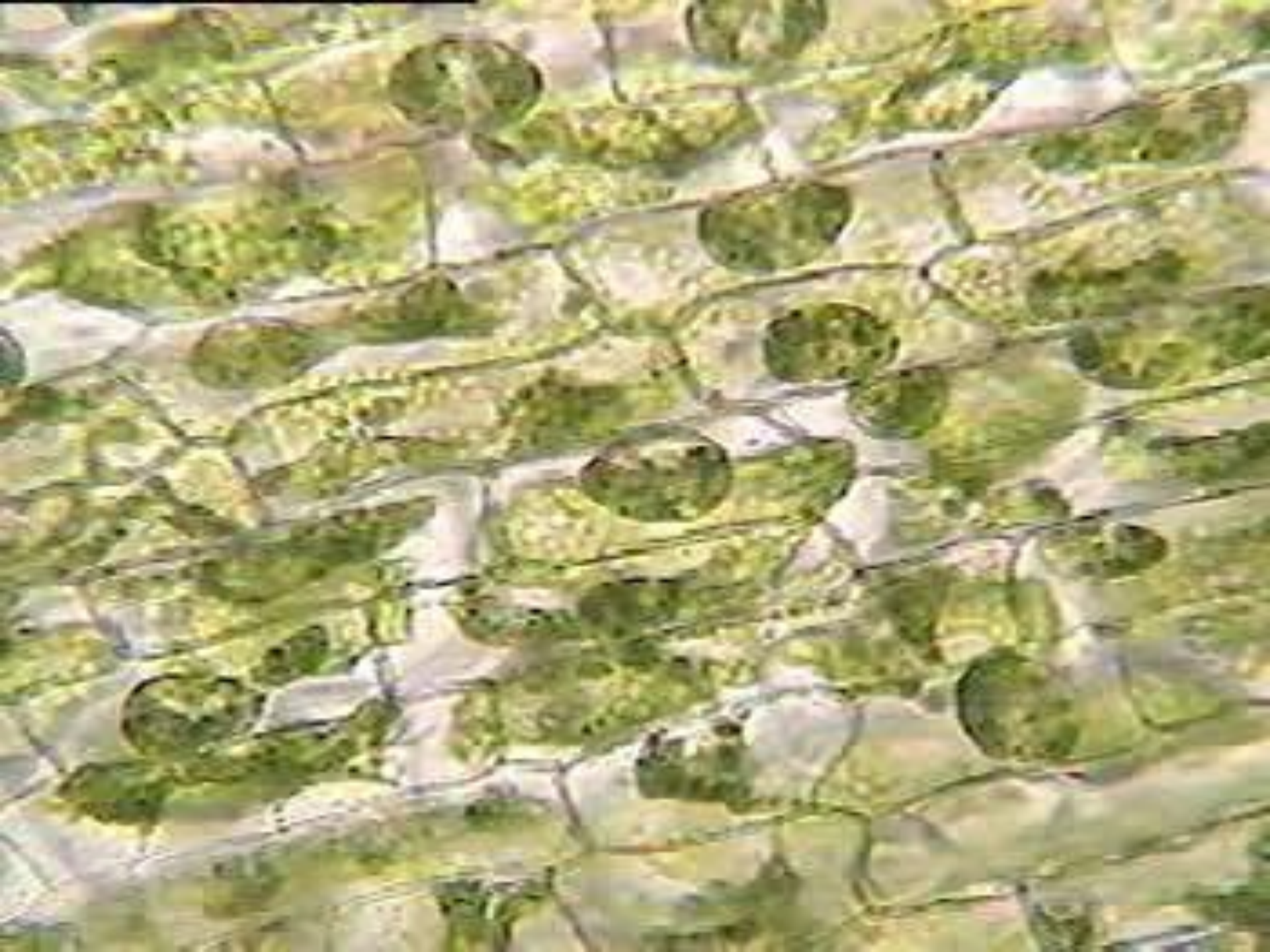
HYPOTONIC: cell swells

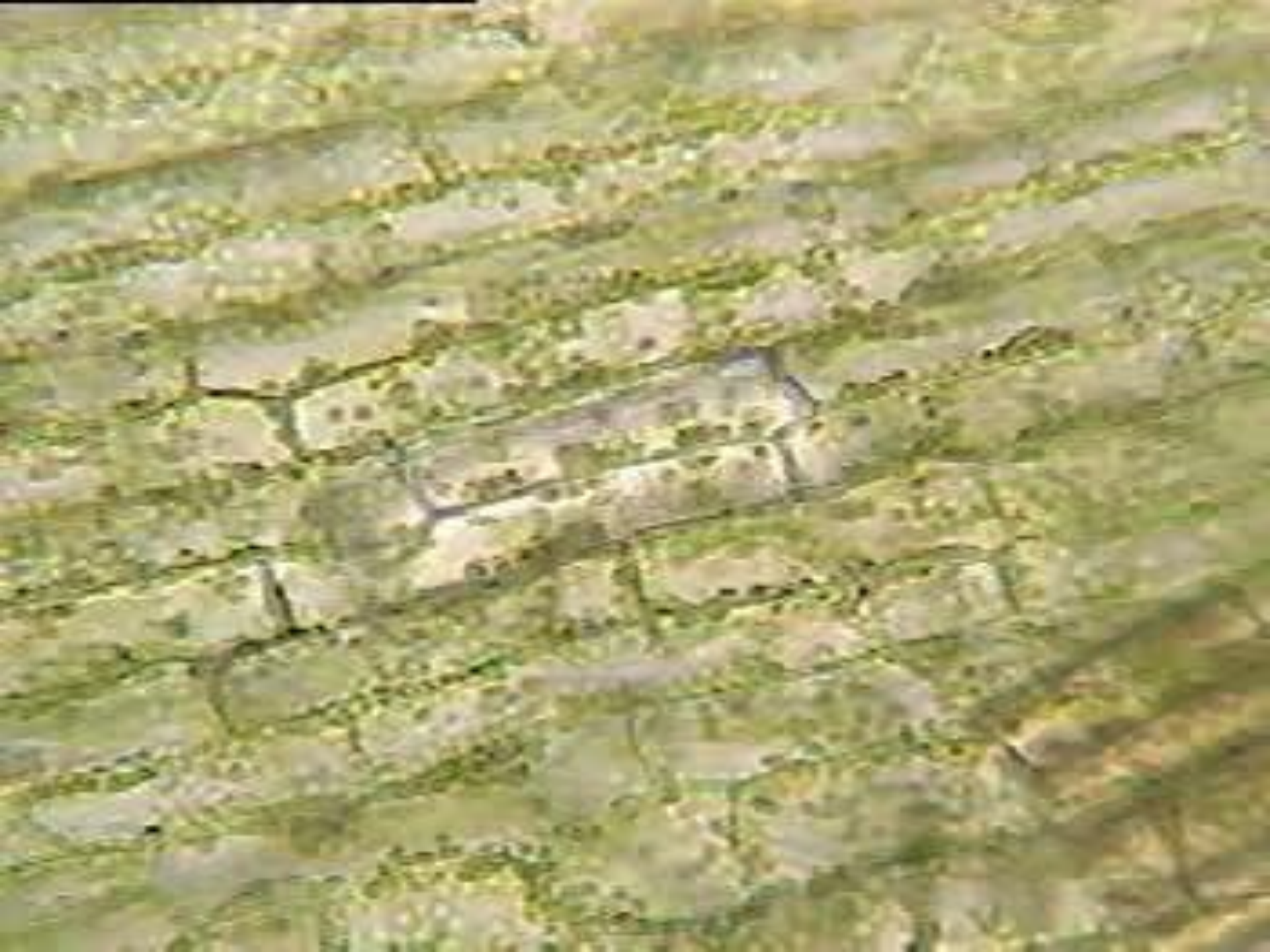


What kind of solution are these cells in?

What would happen in the solution not shown?

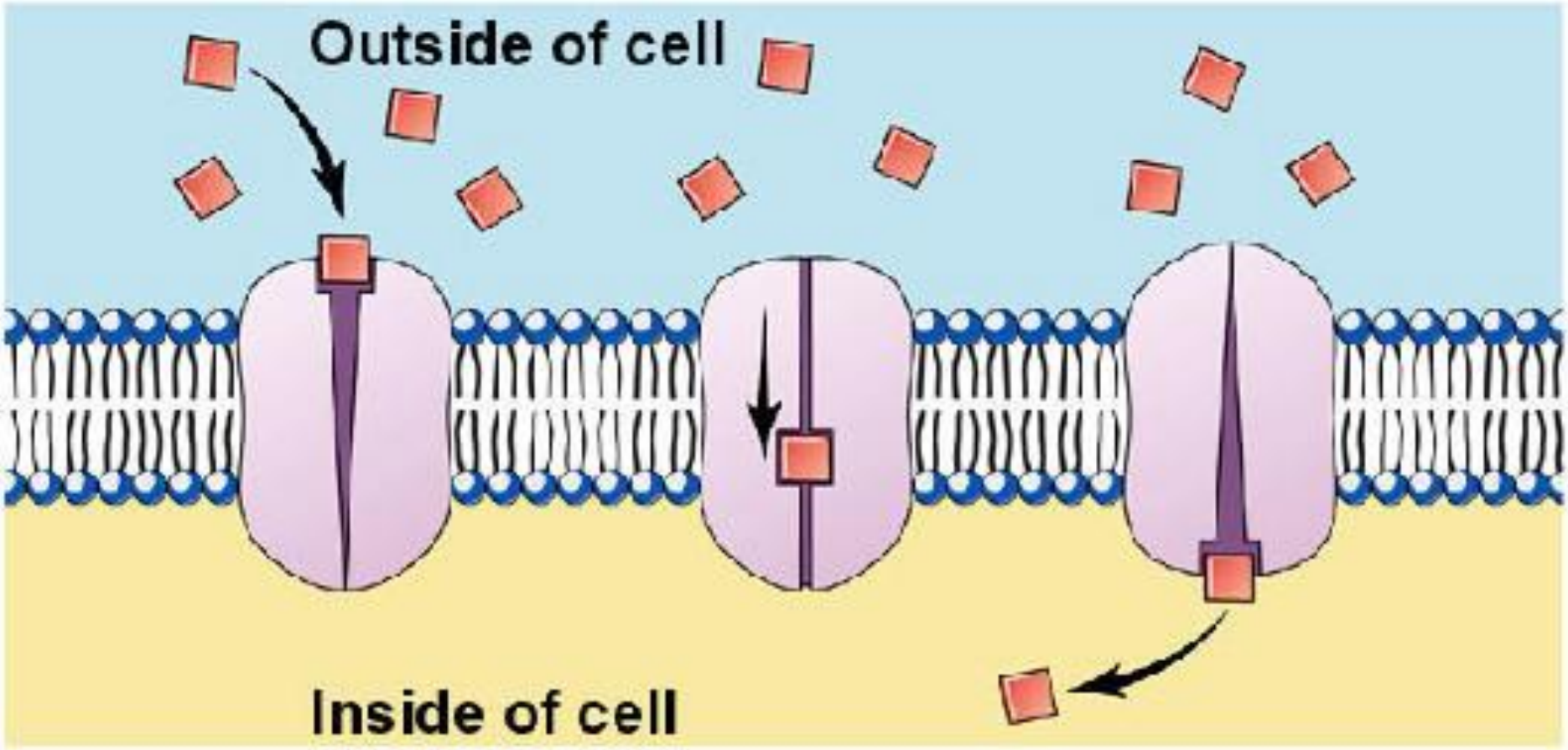

odea / pond weed

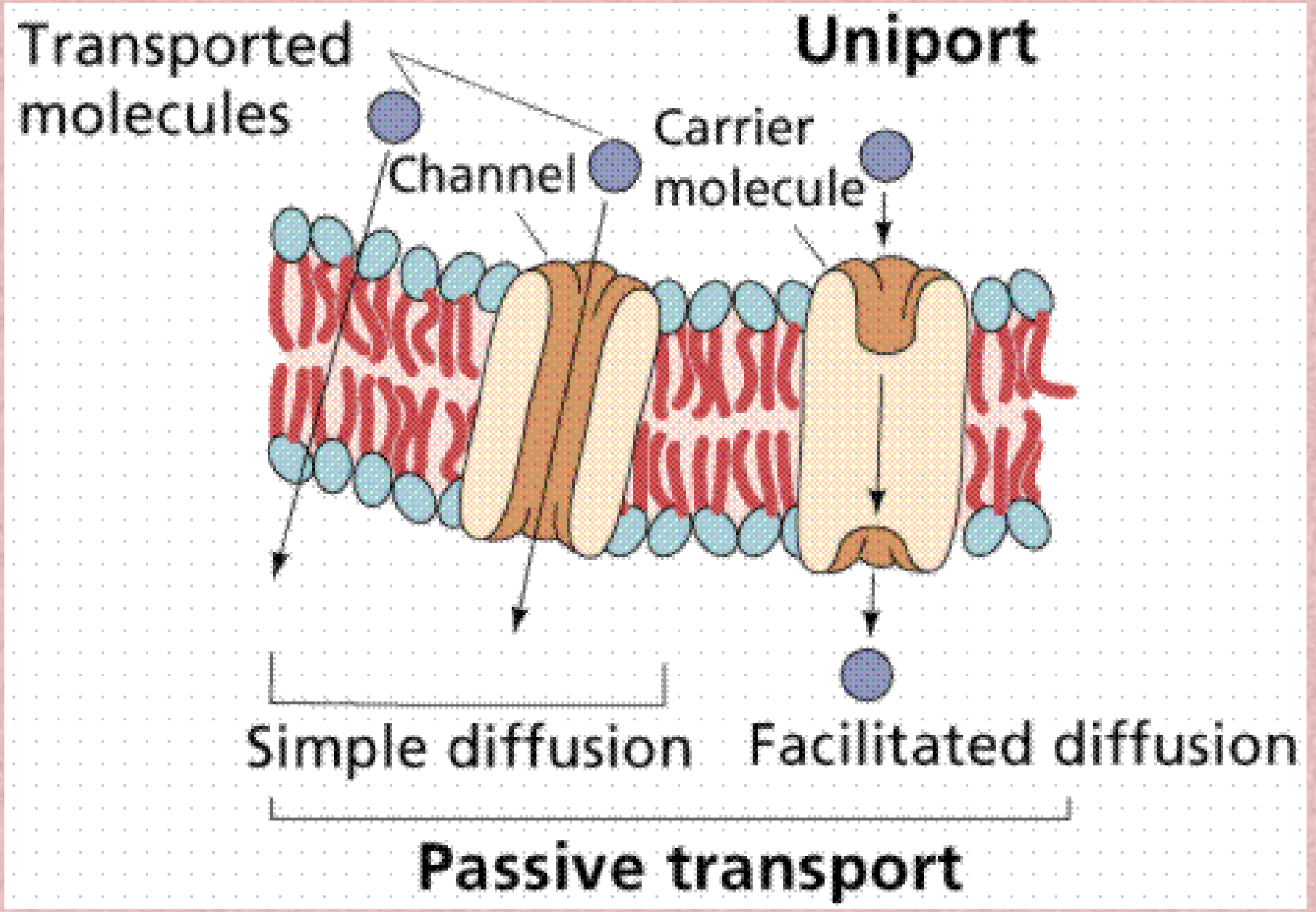




4. Facilitated Diffusion
   a) Protein carrier molecules help move molecules across the cell membrane
   b) Glucose moved in this way

Facilitated Diffusion




Transported molecules
Uniport
Channel
Carrier molecule
Simple diffusion
Facilitated diffusion
Passive transport

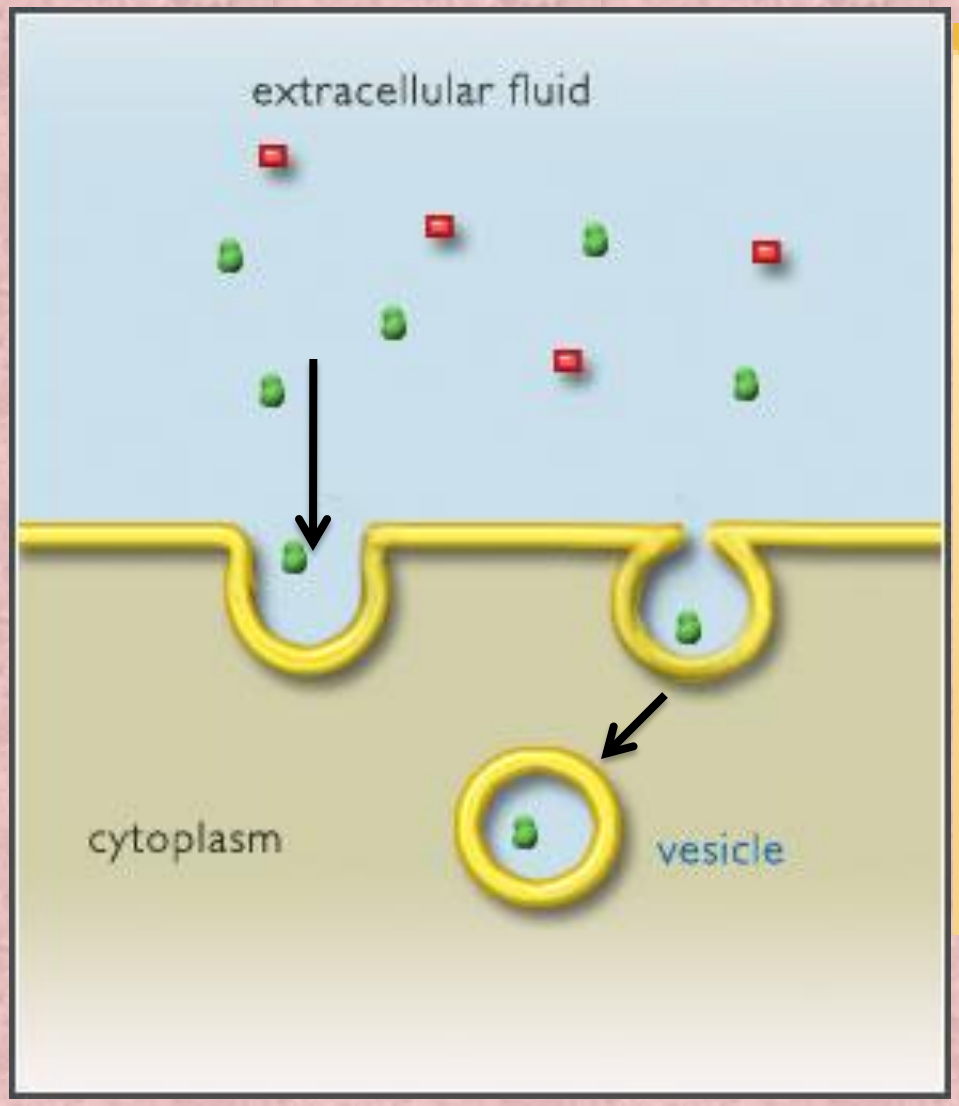
C. Active transport
   1. Requires energy from the cell
   2. Moving materials against the concentration gradient (from low to high)
      - Ex.: Na+/K+ pump in neurons of brain and nerves
   3. Moving large molecules

4. Types of active transport:

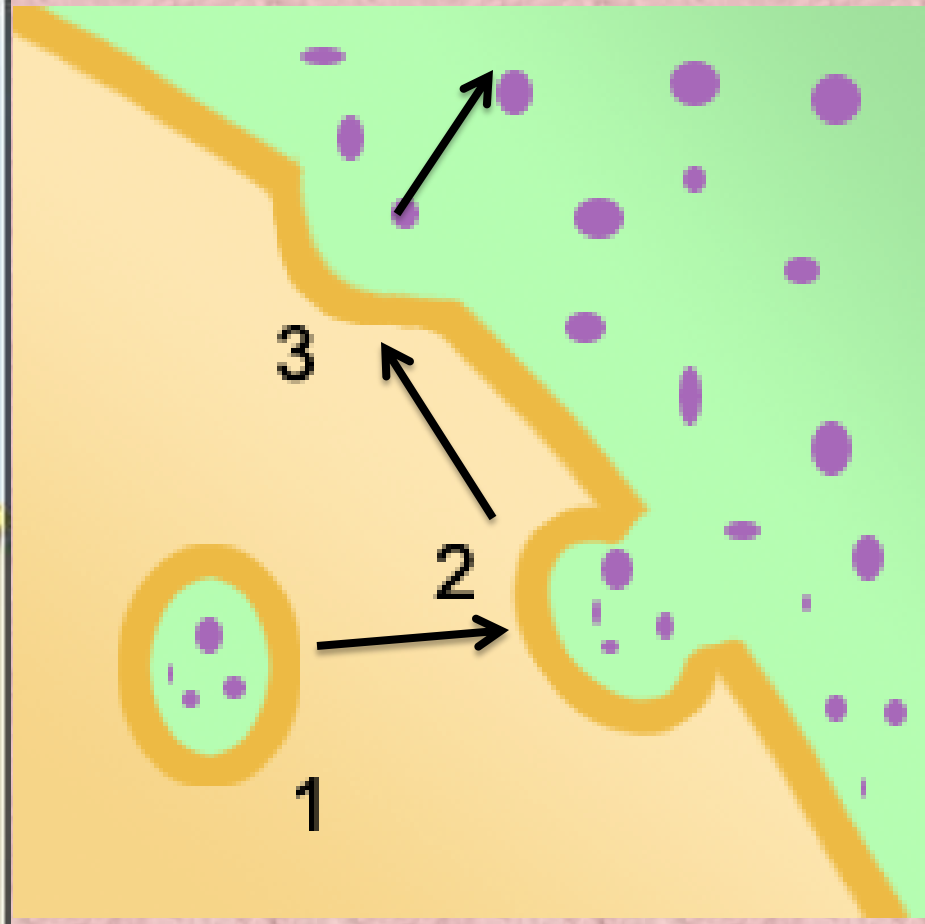
   a) Endocytosis: moving large molecules into a cell by forming vesicles (membrane pockets)

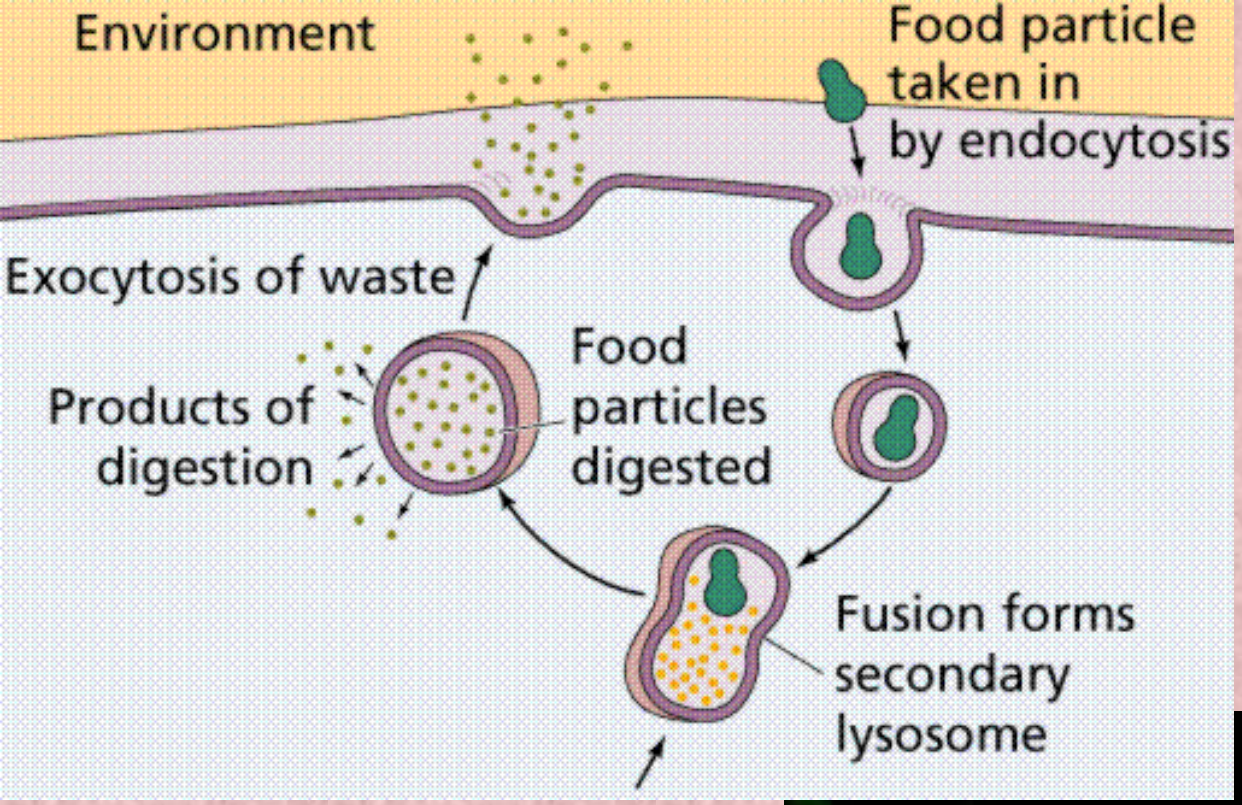
   b) Exocytosis: moving large molecules out of a cell

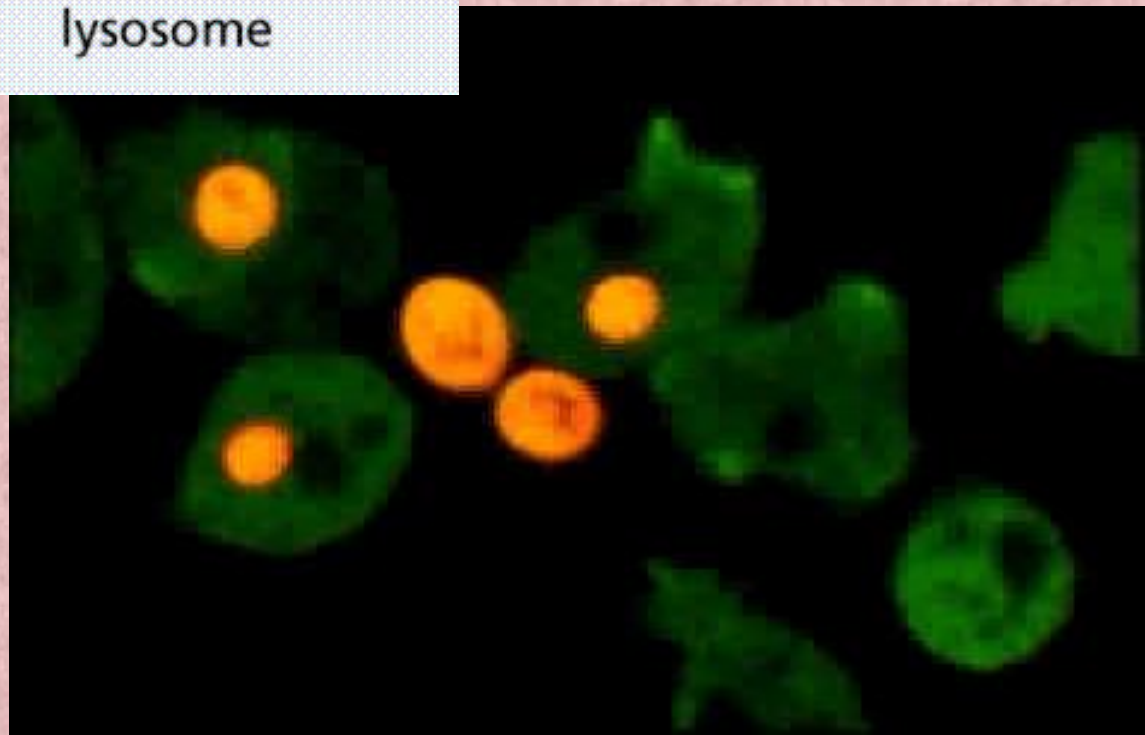
Endocytosis



Exocytosis




Environment
Food particle
taken in
by endocytosis
Exocytosis of waste
Products of
digestion
Food
particles
digested
Fusion forms
secondary
lysosome




Elodea Leaf