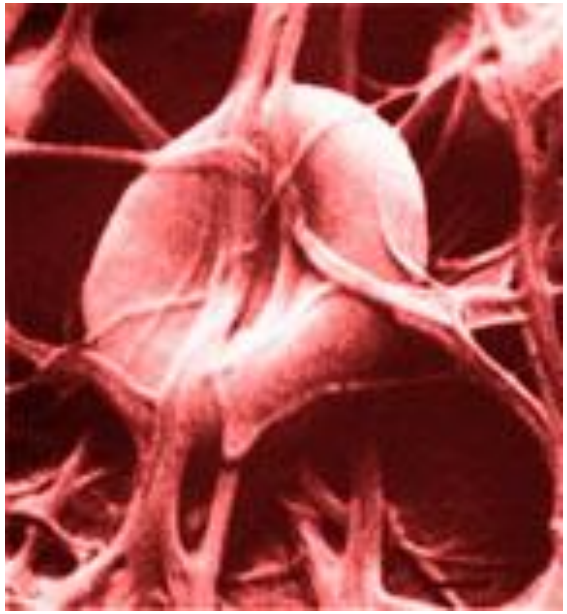
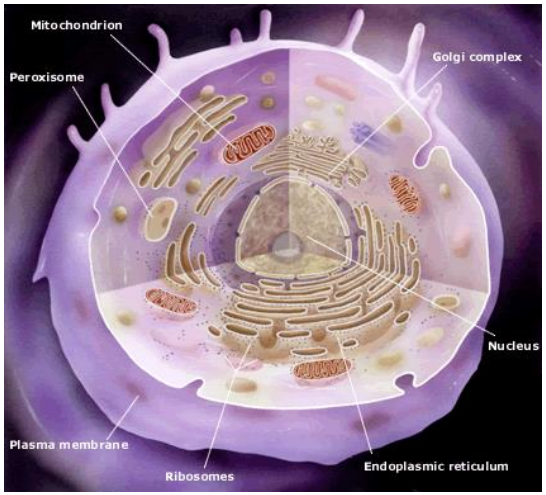
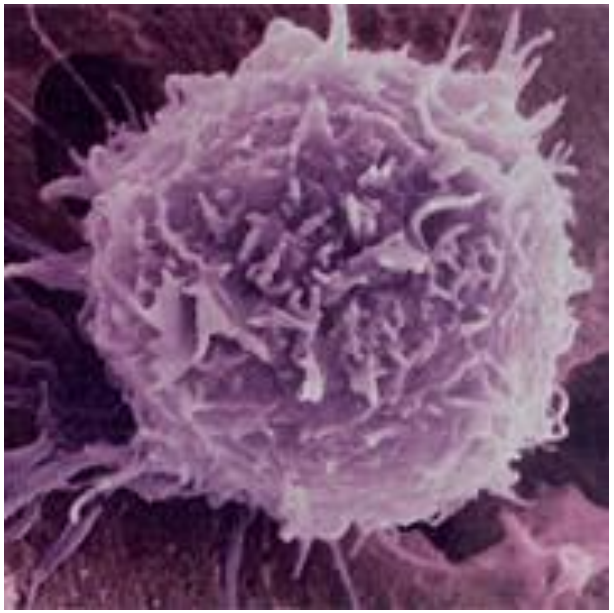
# Cell Structure



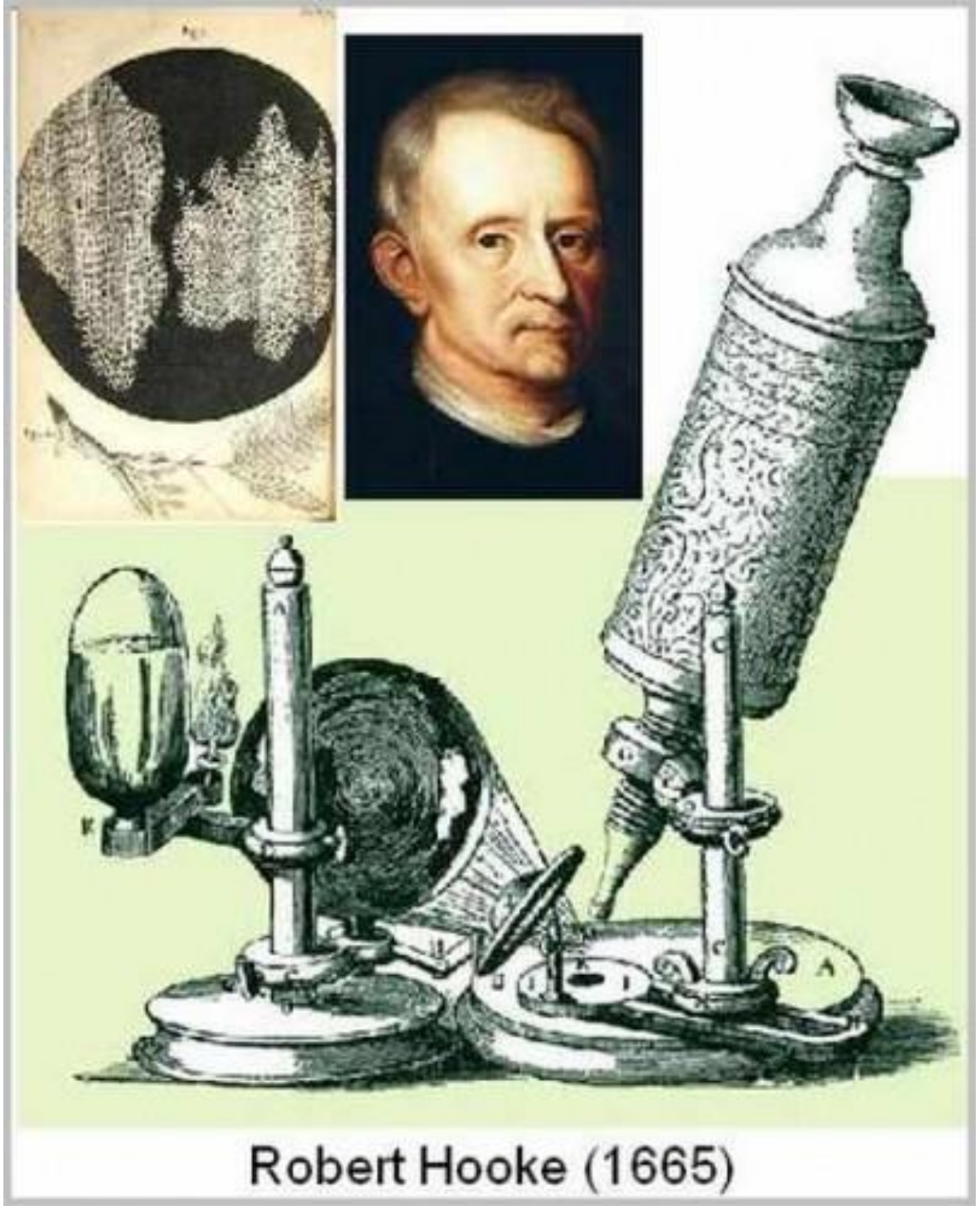


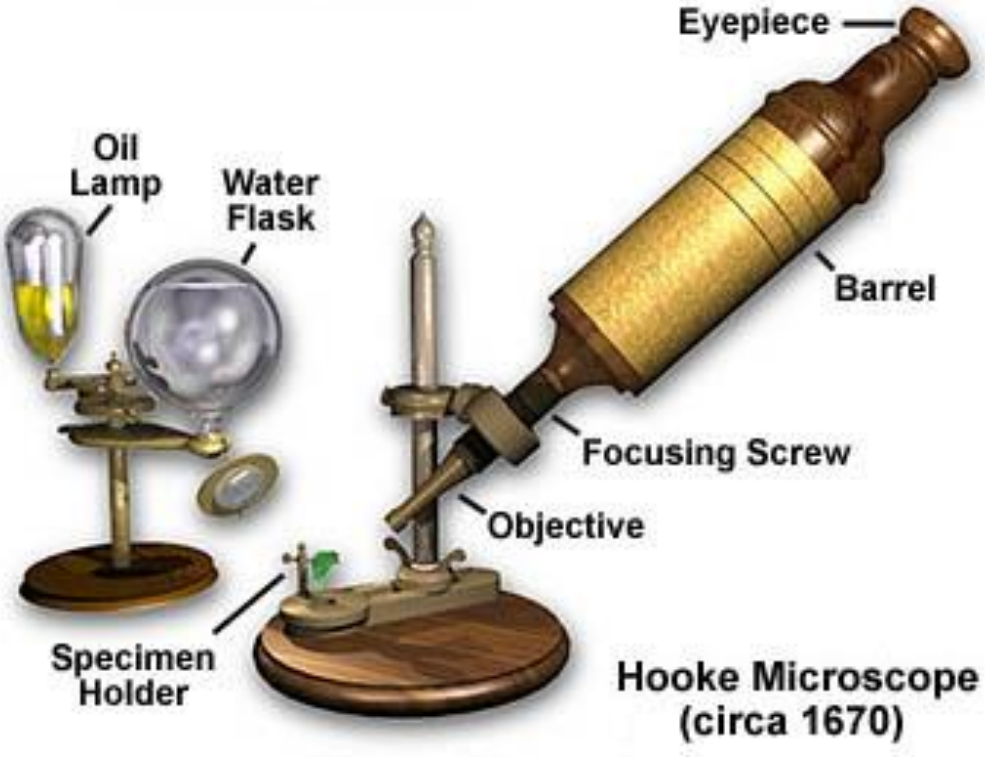
# Discovery of the Cell

Who discovered cells?

- 1665 – Robert Hooke used a compound microscope to examine a piece of cork (20X magnification)
  - He saw little boxes in the cork and called them cells because they looked like the rooms (cells) at the monastery



Robert Hooke (1665)




Hooke Microscope
(circa 1670)

# Discovery of the Cell

Who developed the microscope?

- 1673 – Anton van Leeuwenhoek was the first person to observe living cells: bacteria, sperm, blood, protists
  - Beneficial because we could finally see microscopic organisms and structure of cells
  - Magnification of 200X

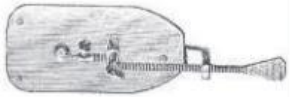
World's Greatest 1000 Creation Scientists 2000

# ANTONY VAN LEEUWENHOEK

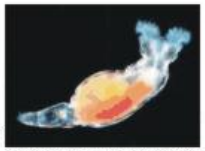
**1632 - 1723**

*Microscopy • Microbiology*

- **Invented a 270x microscope, a tenfold improvement over earlier models**
- **Discovered bacteria, protozoa and rotifers sperm and blood cells; observed for 50 years**
- **No formal scientific training, but elected to the Royal Society**
- **Refuted spontaneous generation of life**



One of Leeuwenhoek's microscopes, approximate actual size (5 cm)



*Philodena*, a rotifer, 220x

***"He often referred with reverence to the wonders God designed in making creatures small and great . . . Leeuwenhoek's life glorified God in many ways, but perhaps most by showing us that there is far more under the sun than we had first suspected."*** – Dan Graves, *Scientists of Faith*

**"It would indeed be a miracle to get these animalcules by chance."**

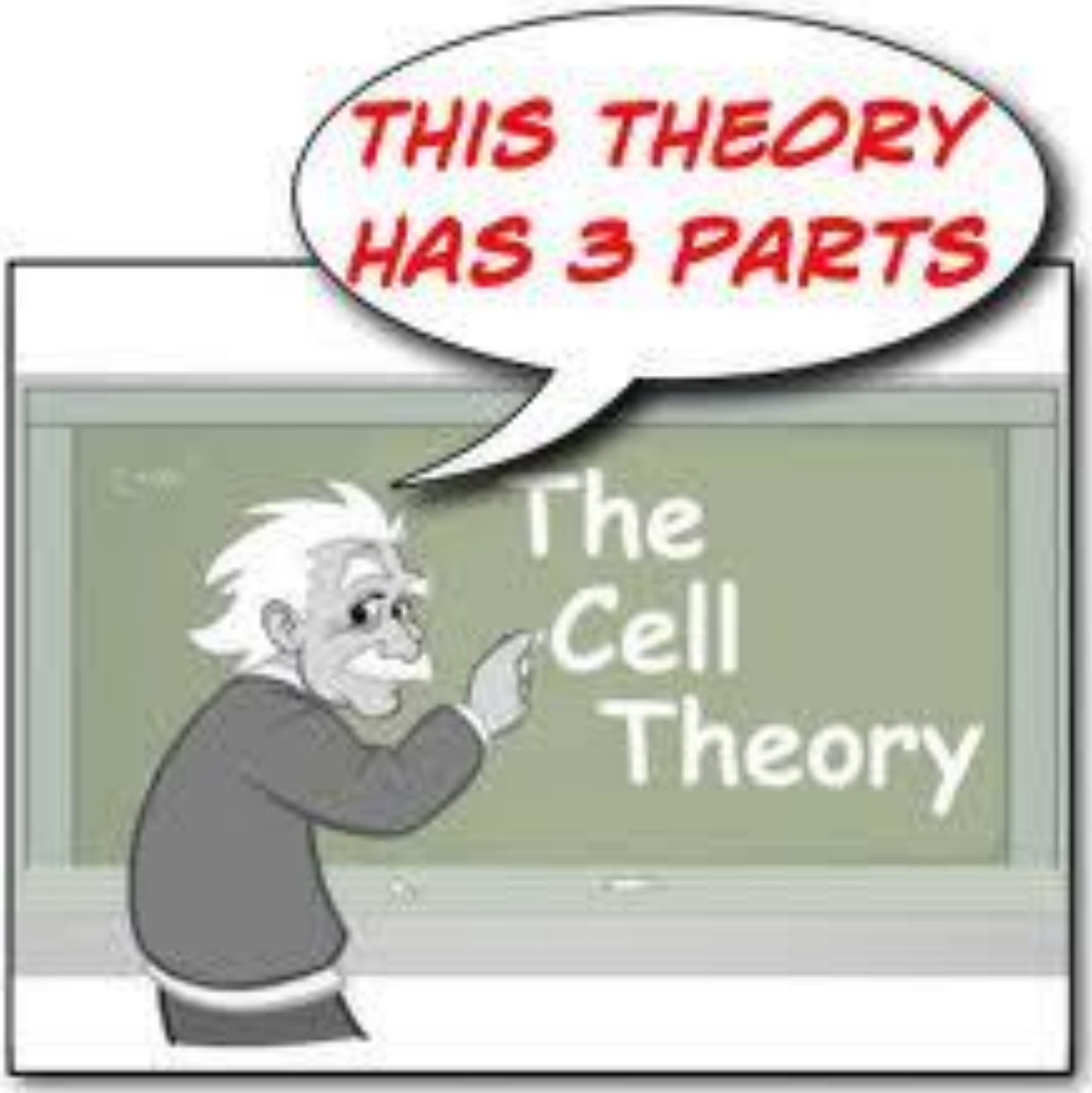
– Antony van Leeuwenhoek

# Cell Theory

- Who developed the theory?

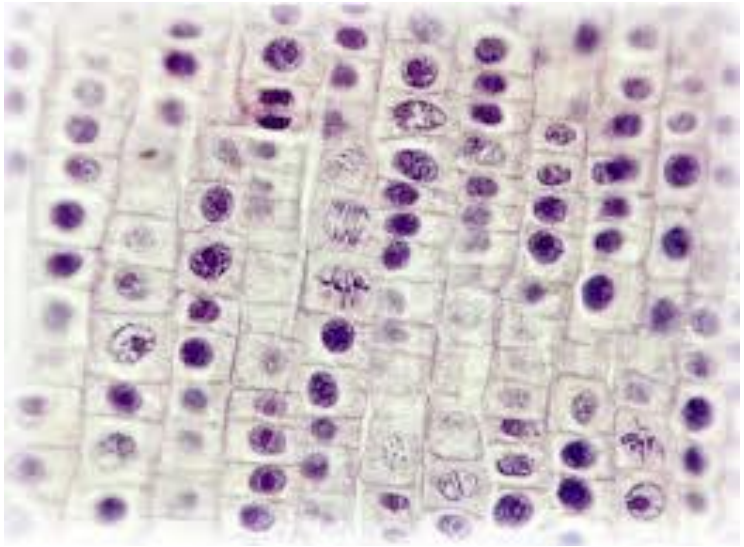
# Cell Theory

- 1838 – Matthias Schleiden concluded that all plants are made of cells.
- 1839 – Theodor Schwann concluded that all animals are made of cells.
- 1855 – Rudolf Virchow reasoned that cells come only from other cells.


THIS THEORY HAS 3 PARTS
The Cell Theory

# Cell Theory

## 1. All living things are made of cells



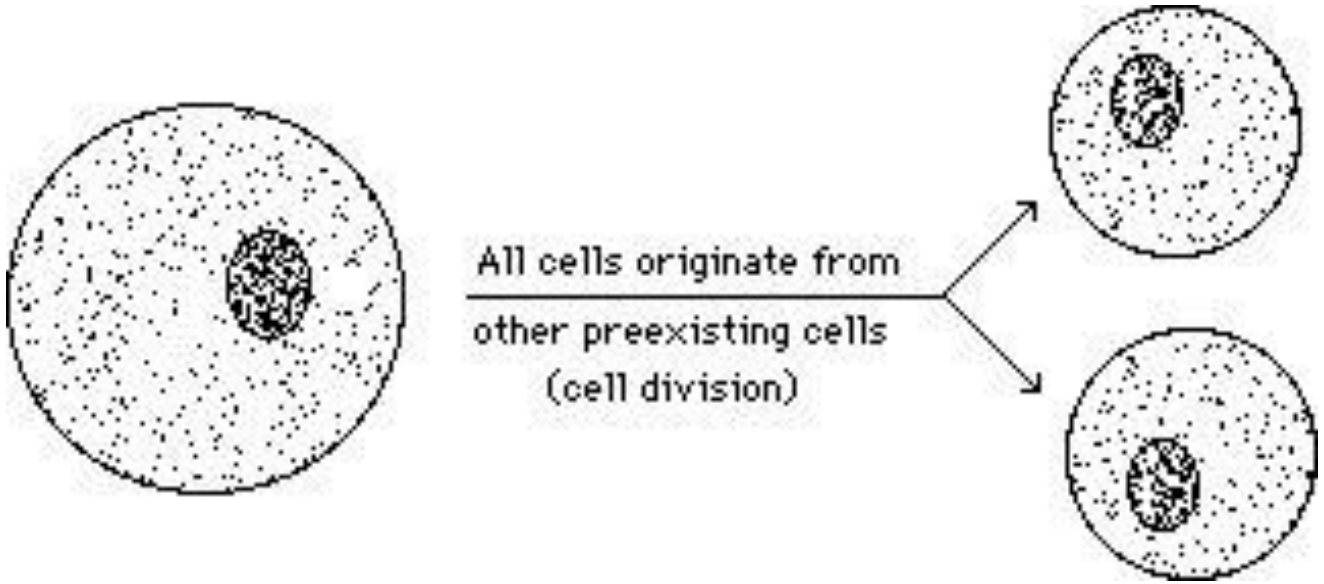
# Cell Theory

## 2. Cells are the basic units of structure and function in living organisms

(nothing is smaller that is still considered living)

# Cell Theory

## 3. Cells come from other cells

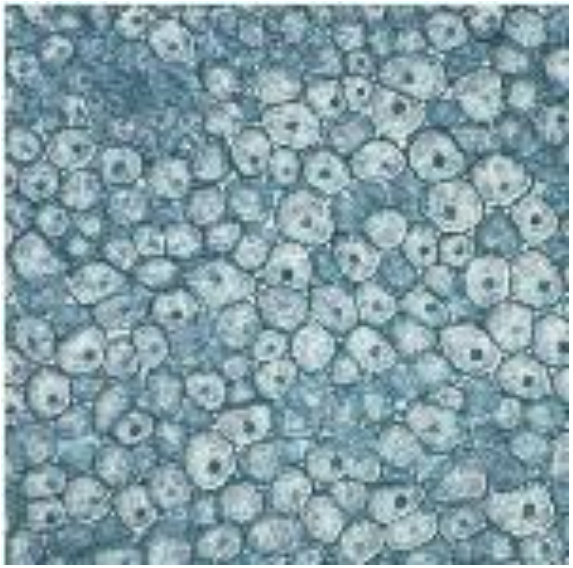


# How do we know cells are alive?

- Reproduce
- Have heredity (DNA)
- Maintains homeostasis
- Grows
- Uses energy
- Responds to its environment
- It is a cell

# The Cell (School Building)

- Cell = highly organize structure contained in a membrane that is the basic unit of structure and function in living things.



# The Cell (School Building)

- Organelle = small structures within a cell with special functions.

# Why do cells need to be small?

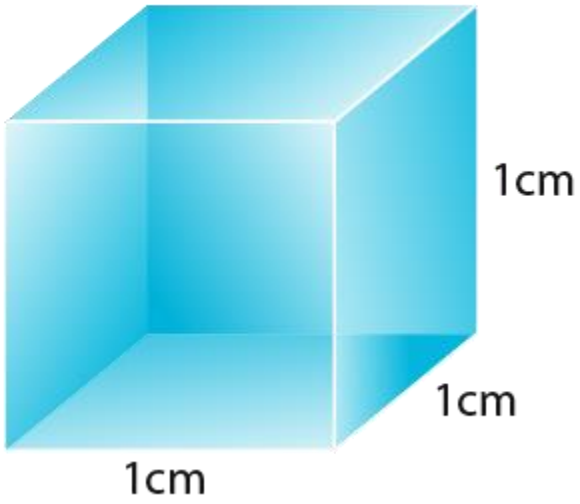
- They will not be able to move enough nutrients into or out the cell to survive

- Cells come in many shapes and sizes
- Cells also have different amounts and types of organelles depending on their function

# Why do cells need to be small?

- Surface area to volume ratios affect a biological system's (cells in this case) ability to obtain resources or eliminate wastes
  - As cells increase in volume, the relative surface area decreases and the demand for resources increases
  - So, smaller cells have a more favorable surface area to volume ratio

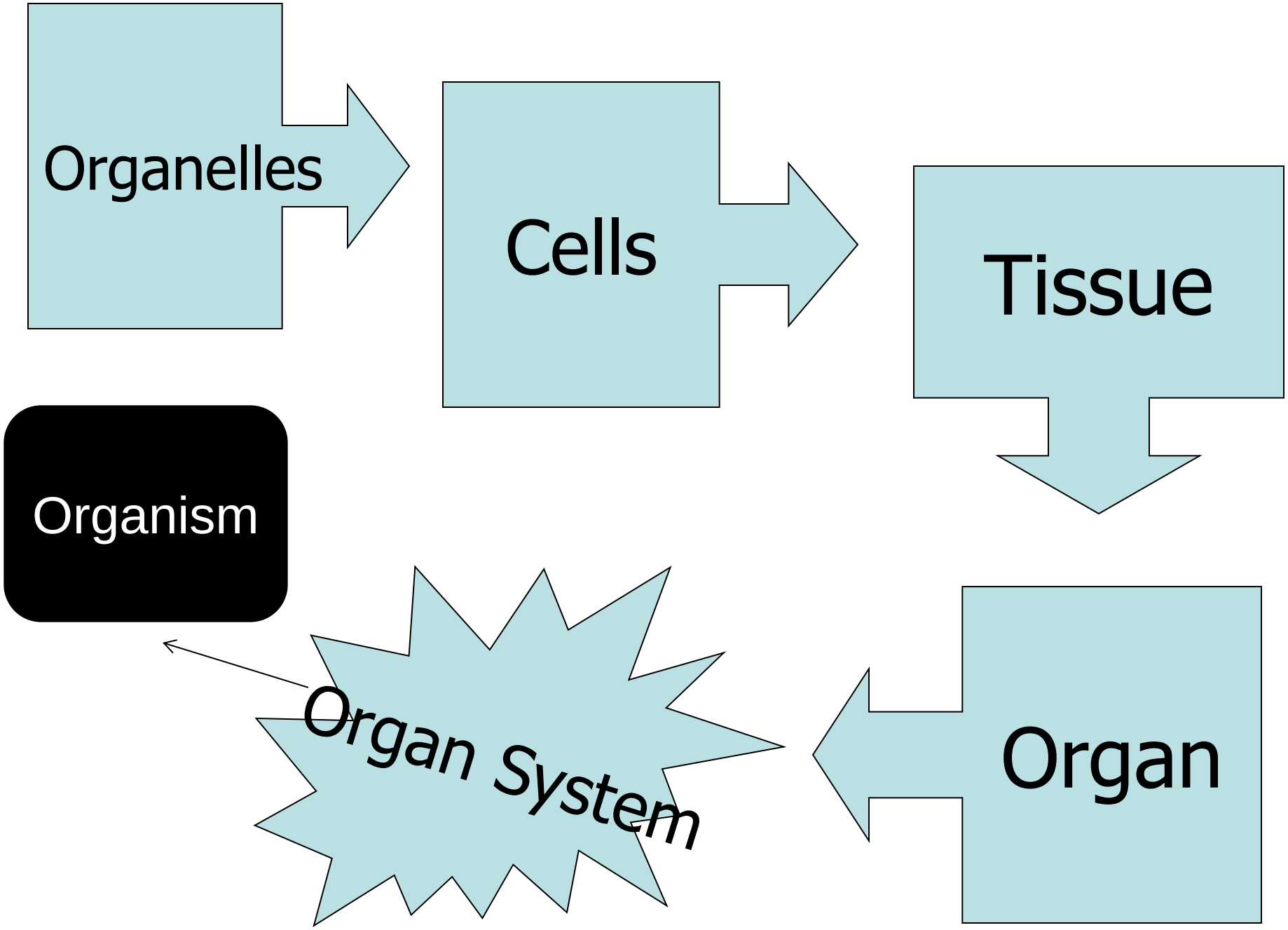
- Example:
  - A cube with 1cm sides
    - SA = 1X1X6 sides = 6
    - V = 1X1X1 = 1
    - SA/V ratio = 6/1 = 6

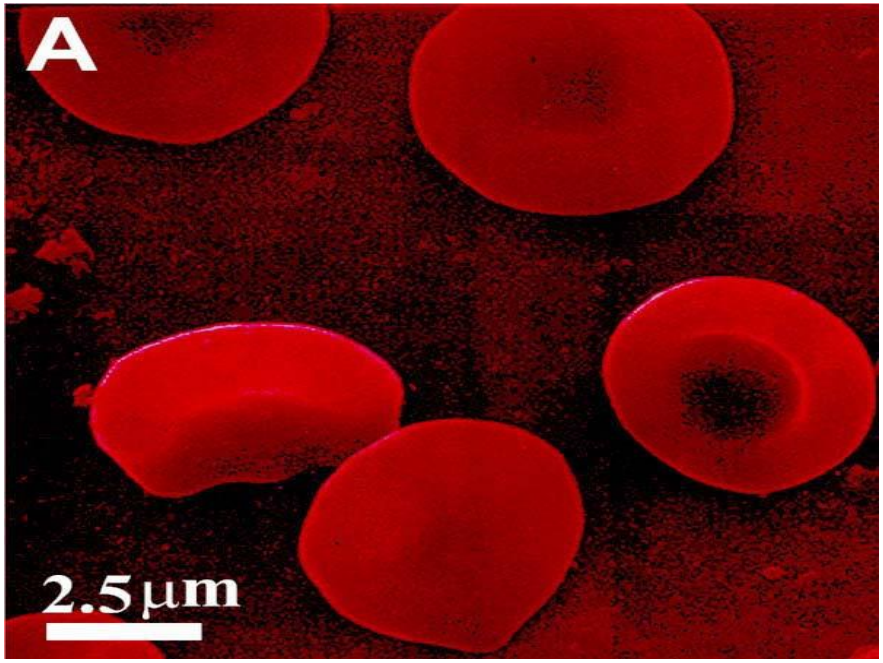


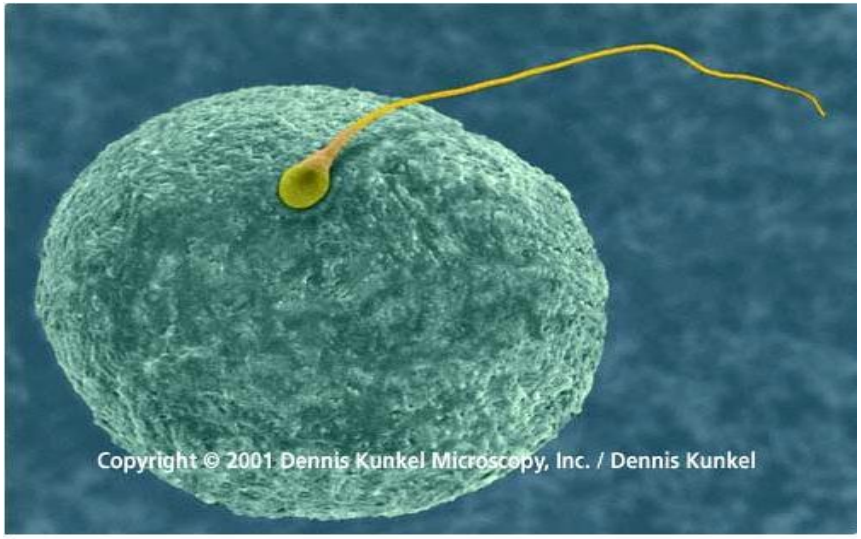

- Example:
  - Solve the surface area-to volume ratio for a 3cm sided cube

# Cellular Organization

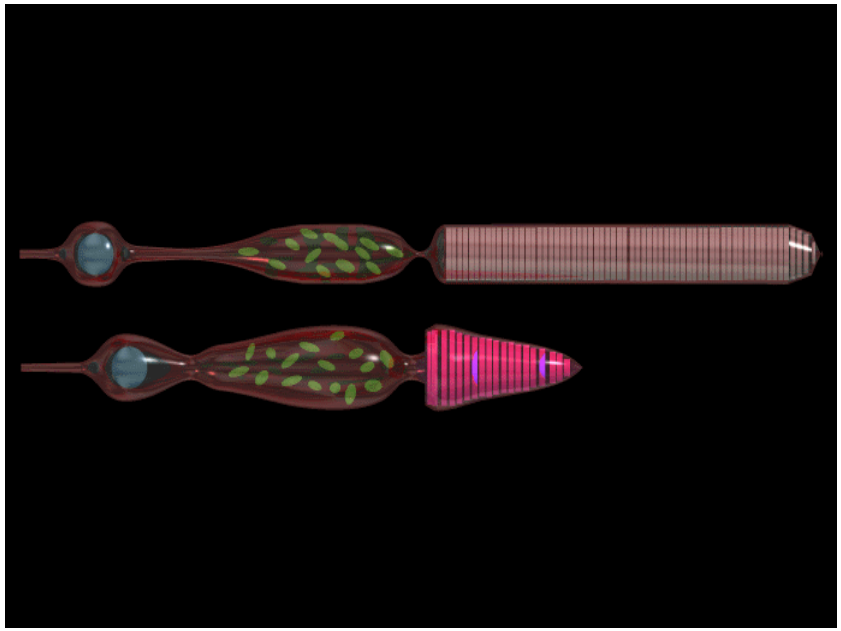
- Cells are composed of many parts, including:
  - Organelles, which are made of
  - Macromolecules (lipids, carbohydrates, proteins, nucleic acids), which are made of
  - Molecules and smaller compounds, which are made of
  - Atoms (carbon, hydrogen, oxygen, nitrogen, and phosphorous)

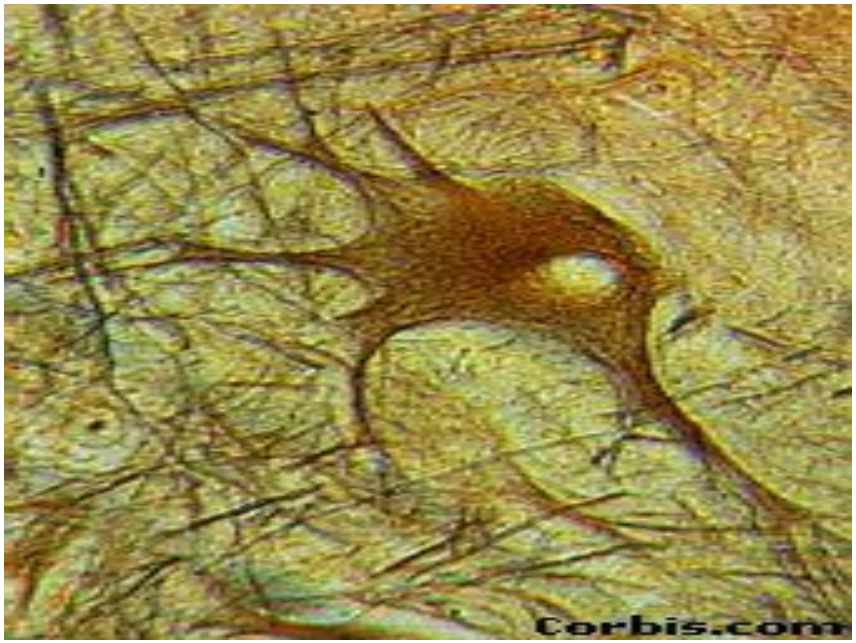

Organelles
Cells
Tissue
Organism
Organ System
Organ




**Caption:** Human egg (oocyte) and sperm (spermatozoon).
**File Name:** 97990A
**Category:** Medical
**Type of Image:** SEM
**Magnification:** egg x260, sperm x560 (Based on an image size of 1 inch in the narrow dimension)





# Types of Cells

- Prokaryotic
  - Structure: no nucleus, no membrane-bound organelles, has ribosomes, unicellular
  - Examples: bacteria

# Types of Cells

- Eukaryotic
  - Structure: nucleus, membrane-bound organelles, unicellular or multicellular
  - Examples: protists, fungi, plants, and animals

# Types of Cells

- Plant Cells
  - Have chloroplasts, cell wall, and large vacuole
- Animals Cells
  - Have centrioles

# Prokaryotic Cells

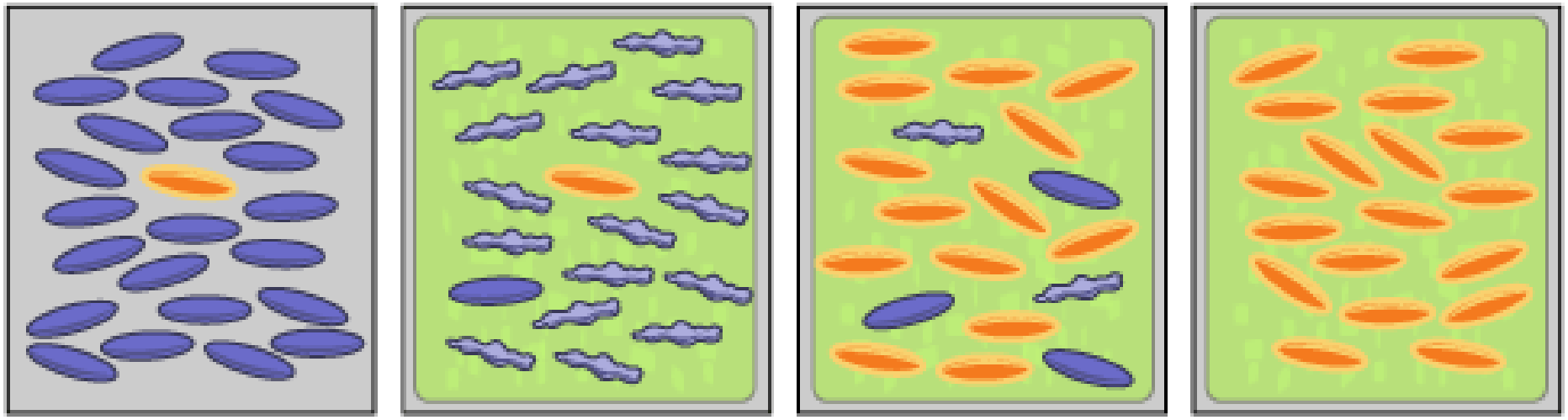
- Antibiotic Resistance
  - Some bacteria cells have started to become resistant to antibiotics
  - The widespread use of the antibiotics are killing off the bacteria without a resistant gene
  - The bacteria that is left have the resistant gene and start to reproduce

A bunch of bacteria, including a resistant variety...

...get bathed in antibiotics. Most of the normal bacteria die.

The resistant bacteria multiply and become more common.

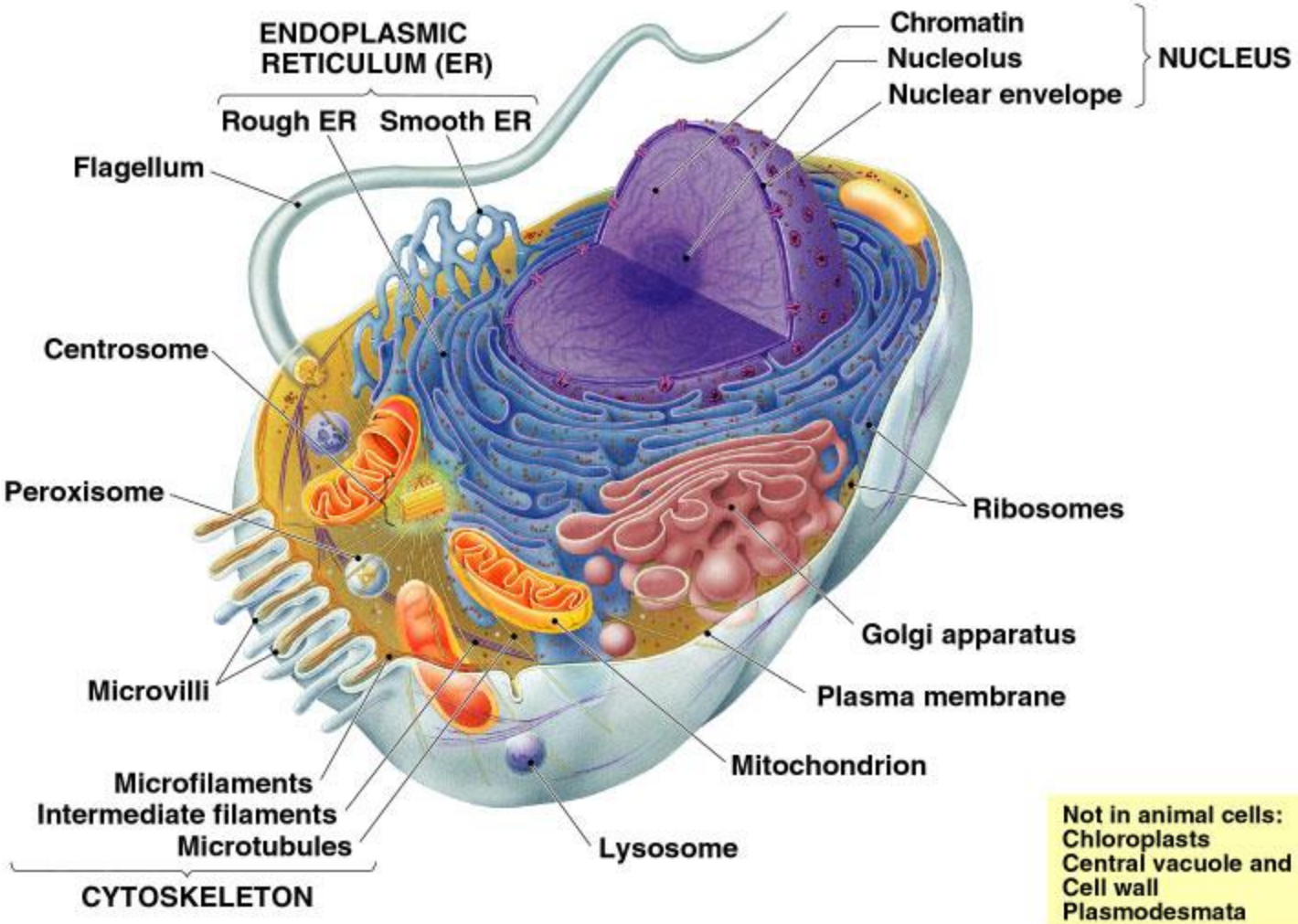
Eventually, the entire infection evolves into a resistant strain.



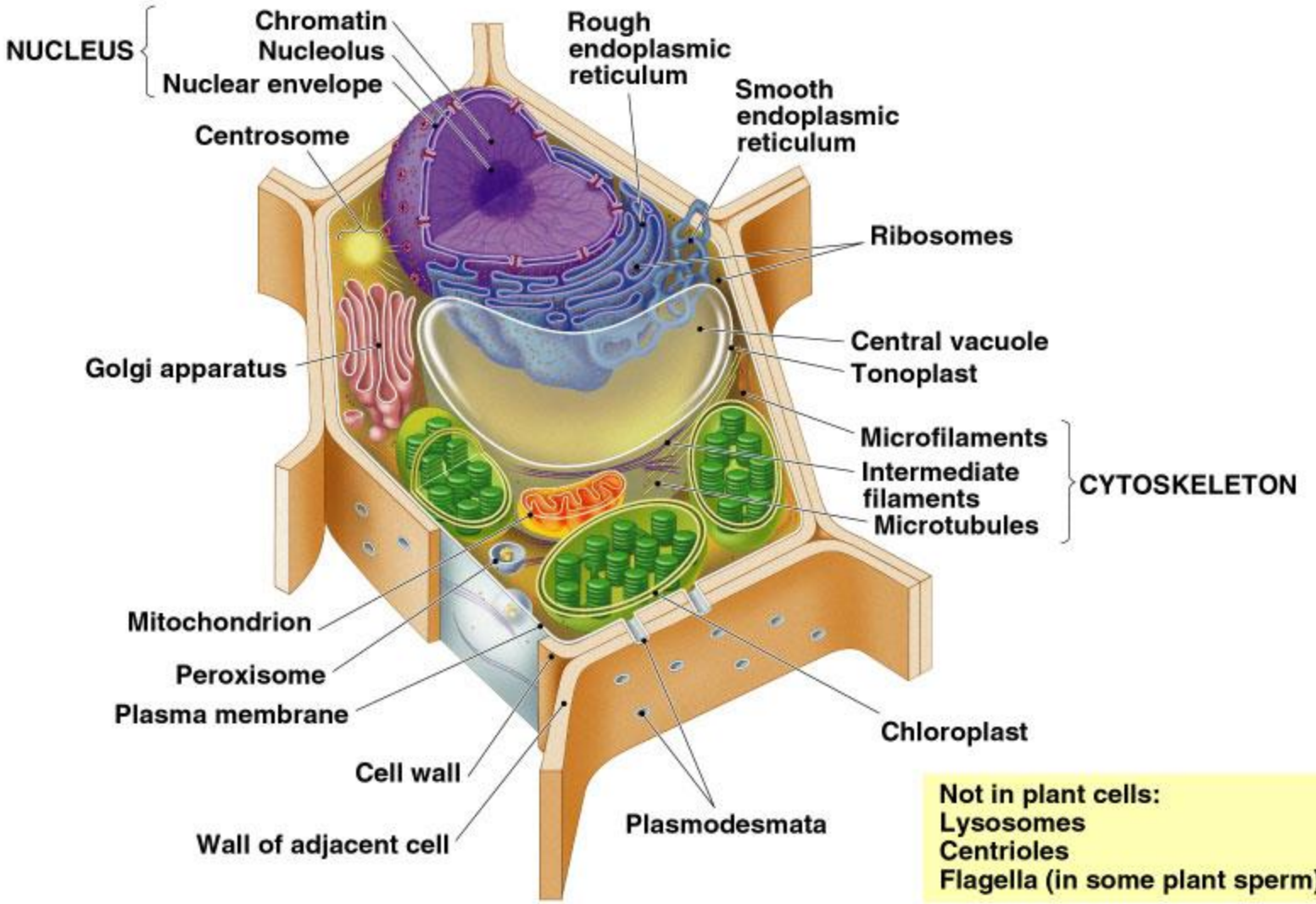
normal bacterium

dead bacterium

resistant bacterium



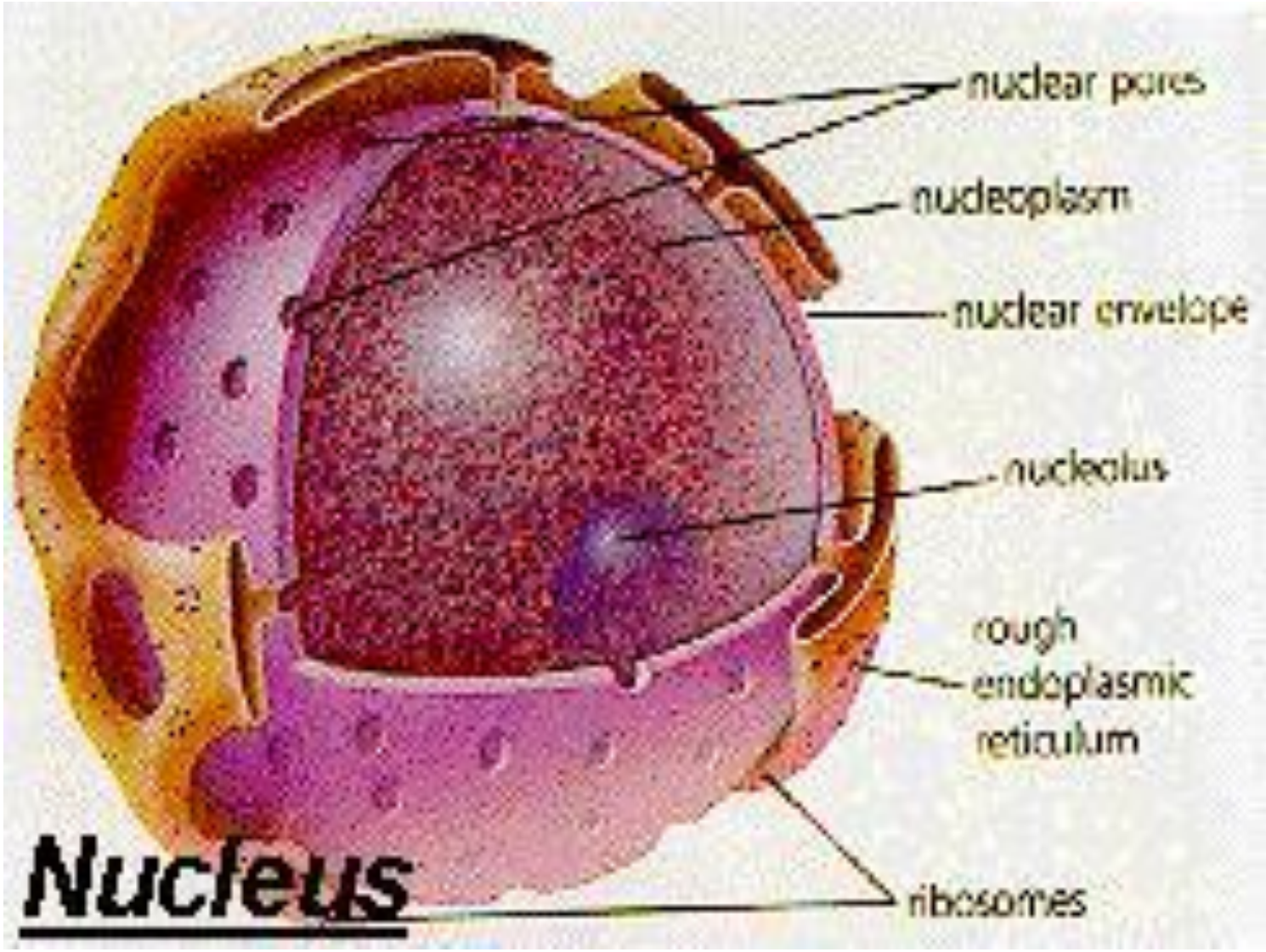

Not in animal cells:
Chloroplasts
Central vacuole and tonoplast
Cell wall
Plasmodesmata



# **Nucleus** (**principal**)

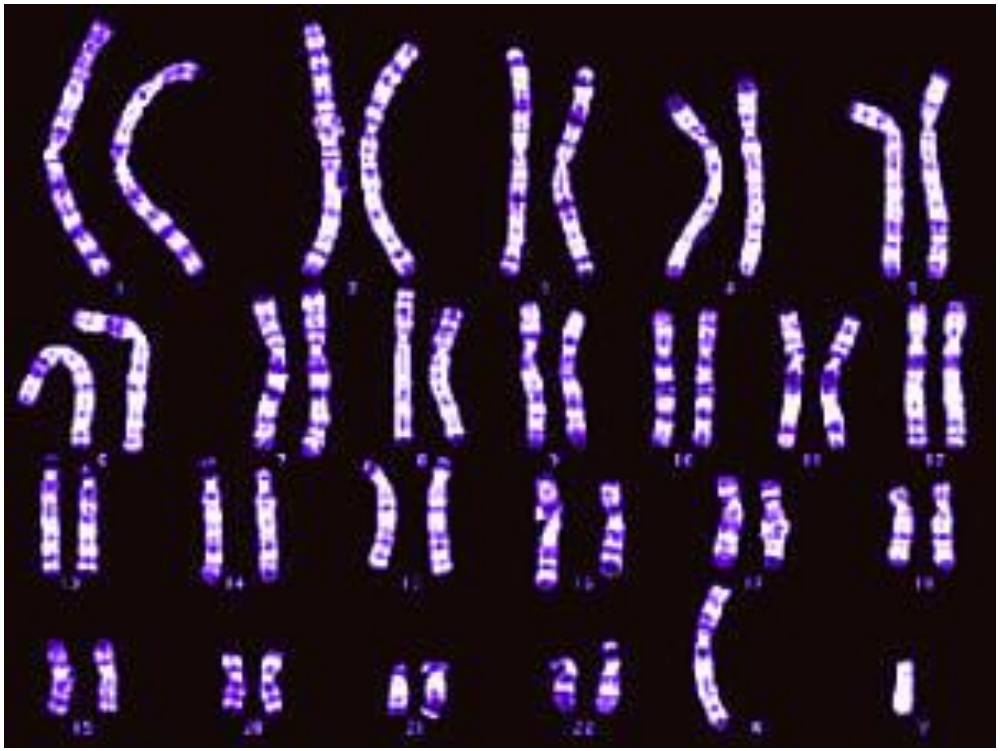
- Function: regulates and controls all the activities within a cell

  - Contains chromosomes (**school rules)** – strands of DNA that hold genetic information
  - Surrounded by the nuclear envelop (phospholipid bilayer)


nuclear pores
nucleoplasm
nuclear envelope
nucleolus
rough
endoplasmic
reticulum
ribosomes
Nucleus

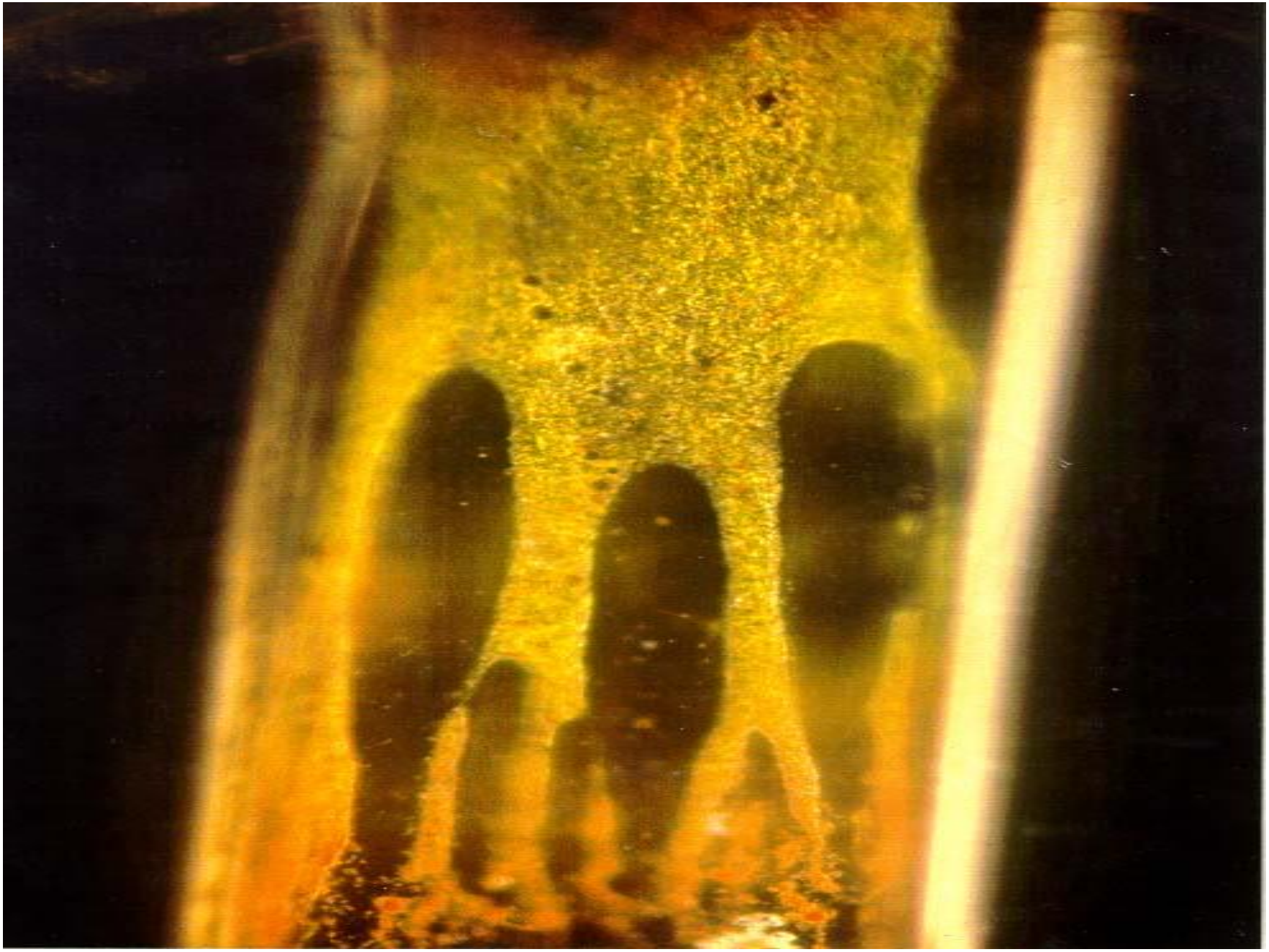
# Nucleolus

- Function: area of DNA that makes ribosomes
  - Located in the nucleus



# Cytoplasm

- Function: fluid that holds organelles in place and site of chemical reactions
  - –A gel-like substance within the cell



# Cytoskeleton (studs in walls)

- Function: provides internal support for the cell
  - Long strands of protein located within the cytoplasm

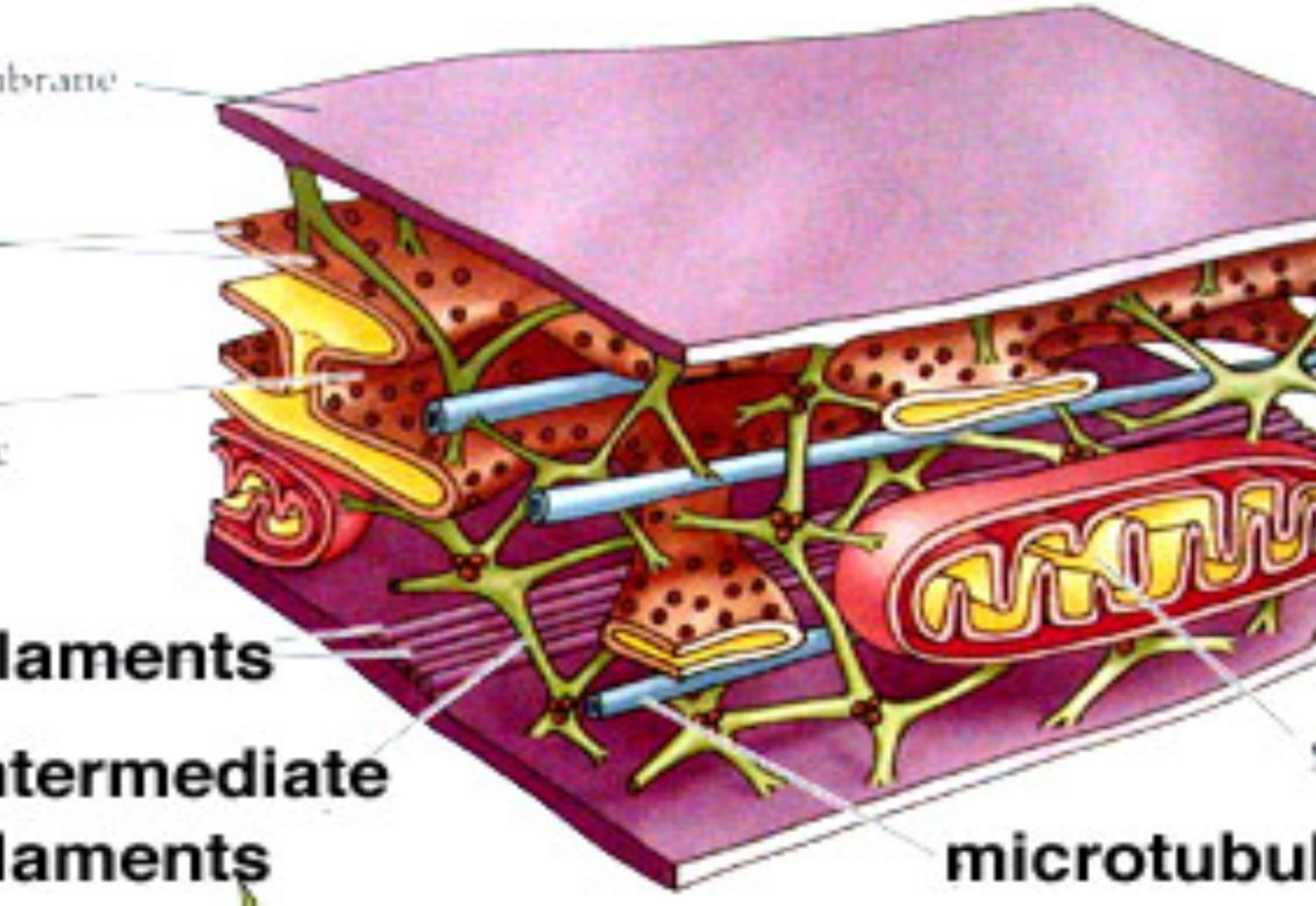
# Types of Cytoskeleton

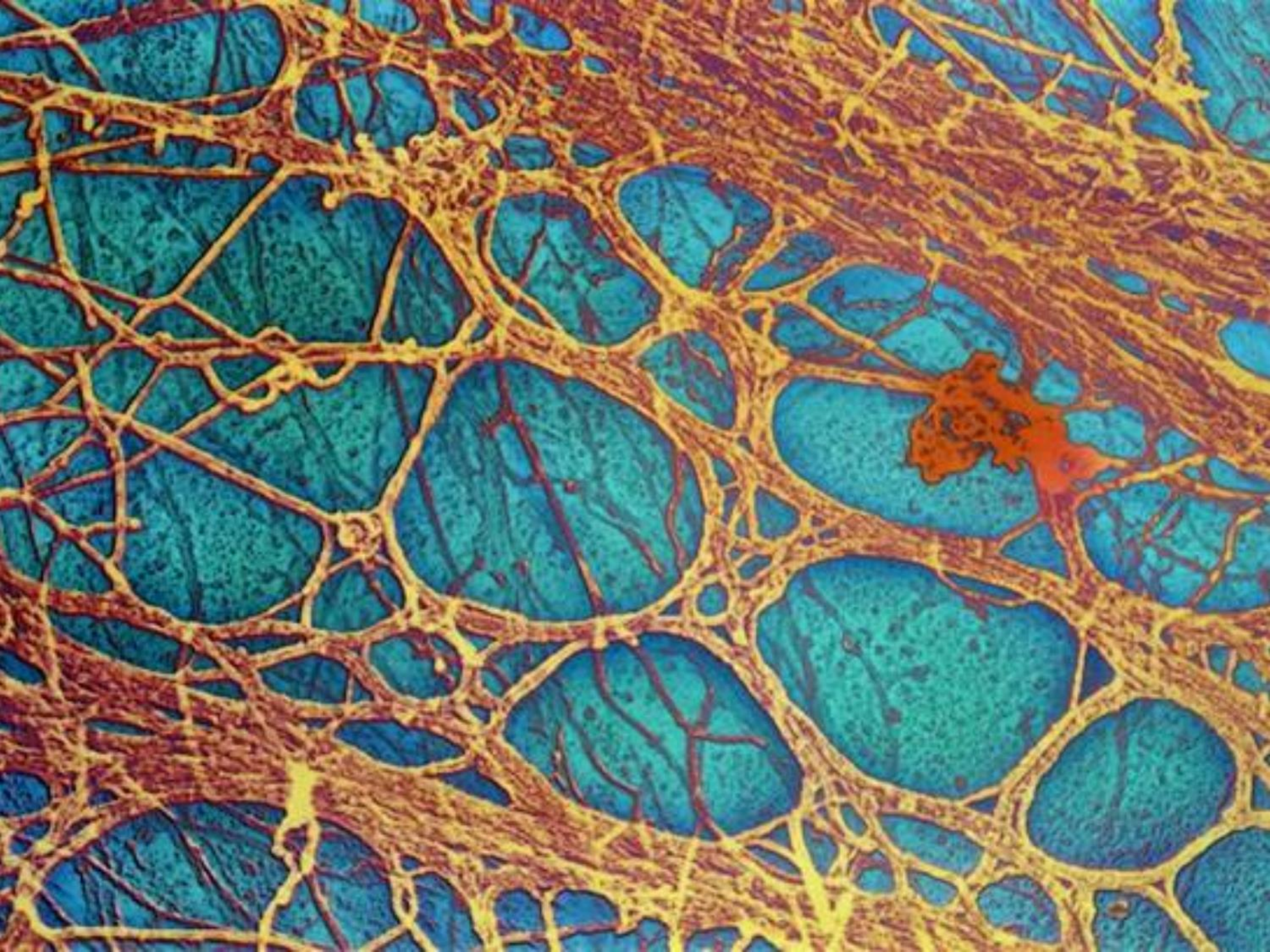
- Microtubules – thickest and used to maintain cell shape, cell motility, and chromosome separation
  - Centrosome – region near nucleus from which microtubules (spindle fibers) grow
  - Centrioles – sets of microtubules that are used to coordinate cell division
  - Flagella – cell movement
  - Cilia – short projections along the outside of the cell to move the cell

# Types of Cytoskeleton

- Microfilaments – thinnest and used to maintain cell shape, cell motility and division, and muscle contraction
  - Example is Actin protein

- Intermediate filaments – middle diameter and used to maintain cell shape
  - Example is Keratin

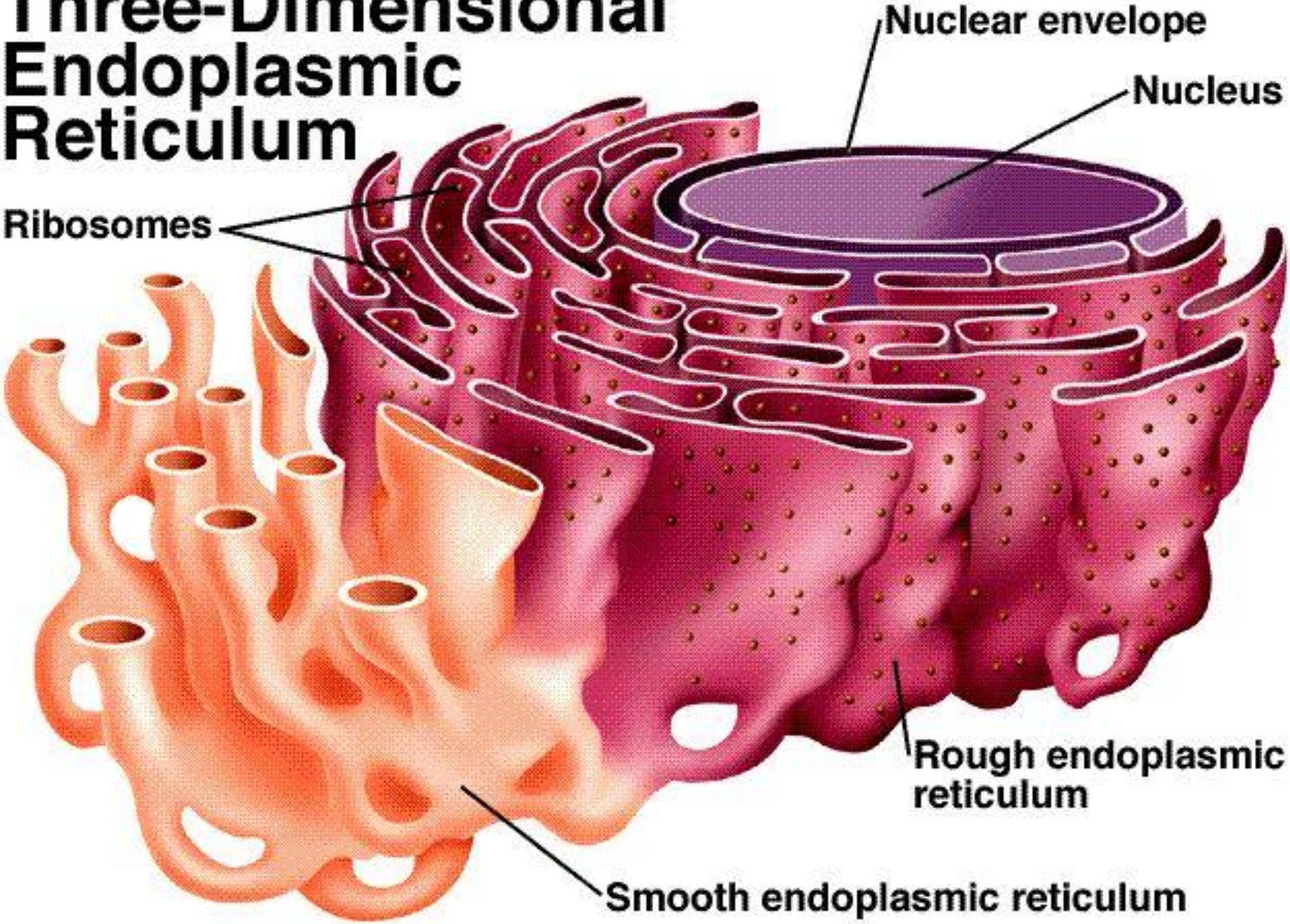

laments
termediate
laments
microtubul



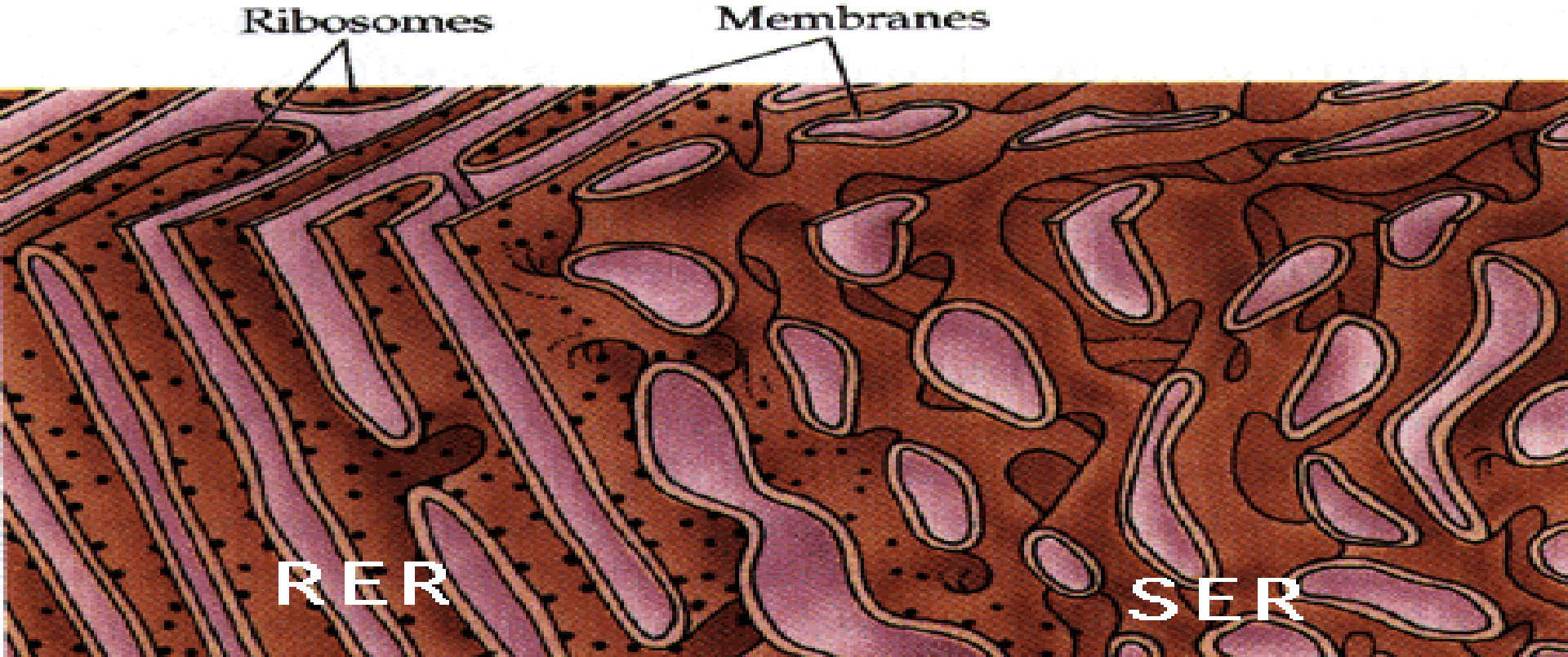
# Endoplasmic Reticulum (halls)

- Function: transports materials around the cell
  - Can be rough (with ribosomes attached) or smooth (without ribosomes attached)
  - Small storage sacs called vesicles bud off of the membrane

# Three-Dimensional Endoplasmic Reticulum




RER
SER


Ribosomes
Membranes
RER
SER

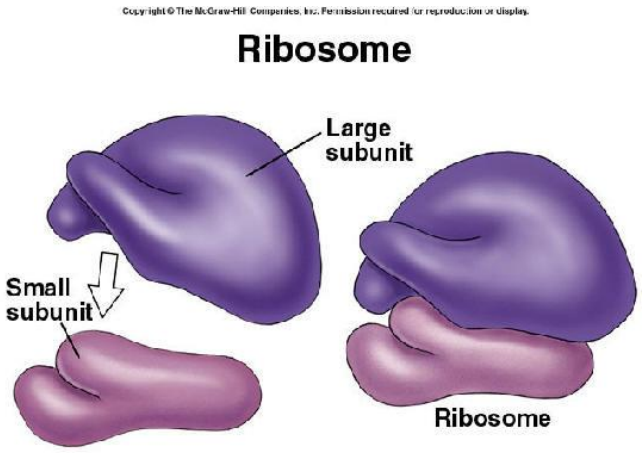
# Ribosomes (students)

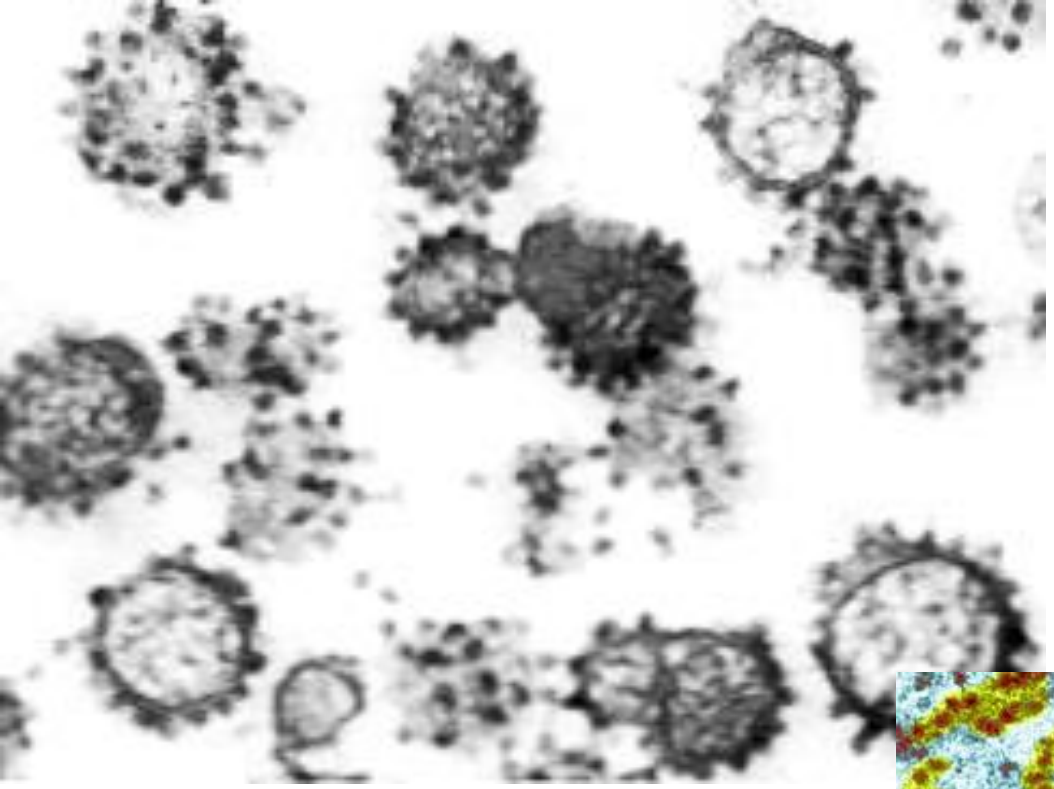
- Function: site of protein synthesis
  - –Some float throughout the cytoplasm, some are attached to the ER

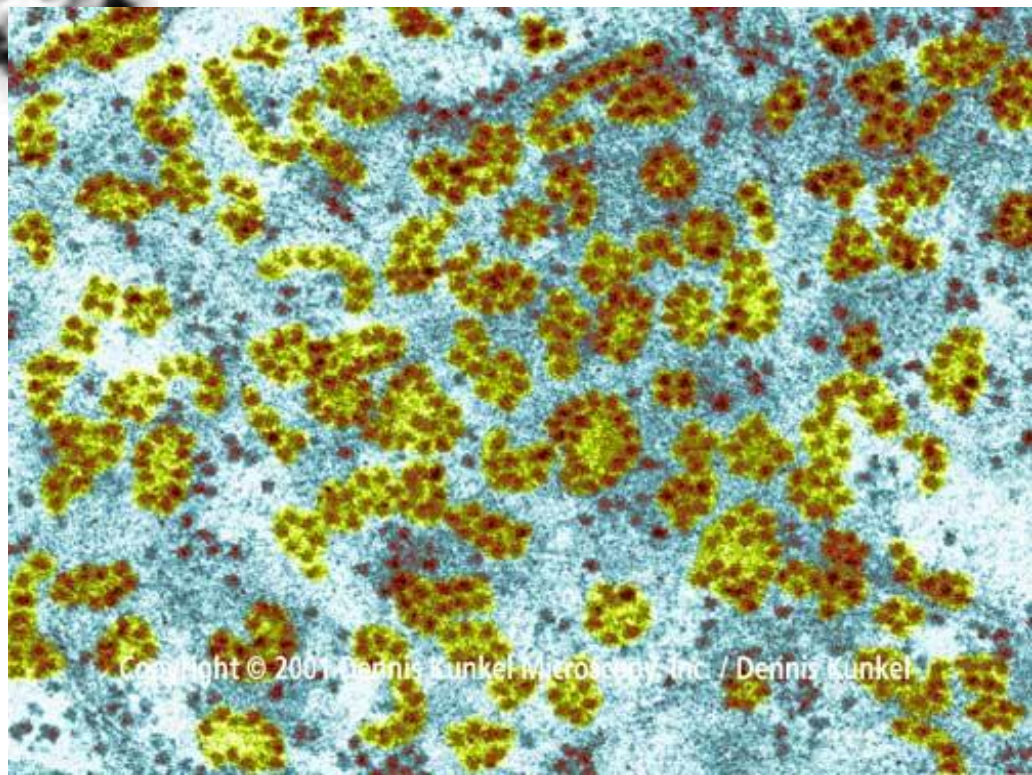
# Ribosomes

- Prokaryotic cells also have ribosomes but are smaller in structure

- Eukaryotic ribosomes are composed on a small and large subunits

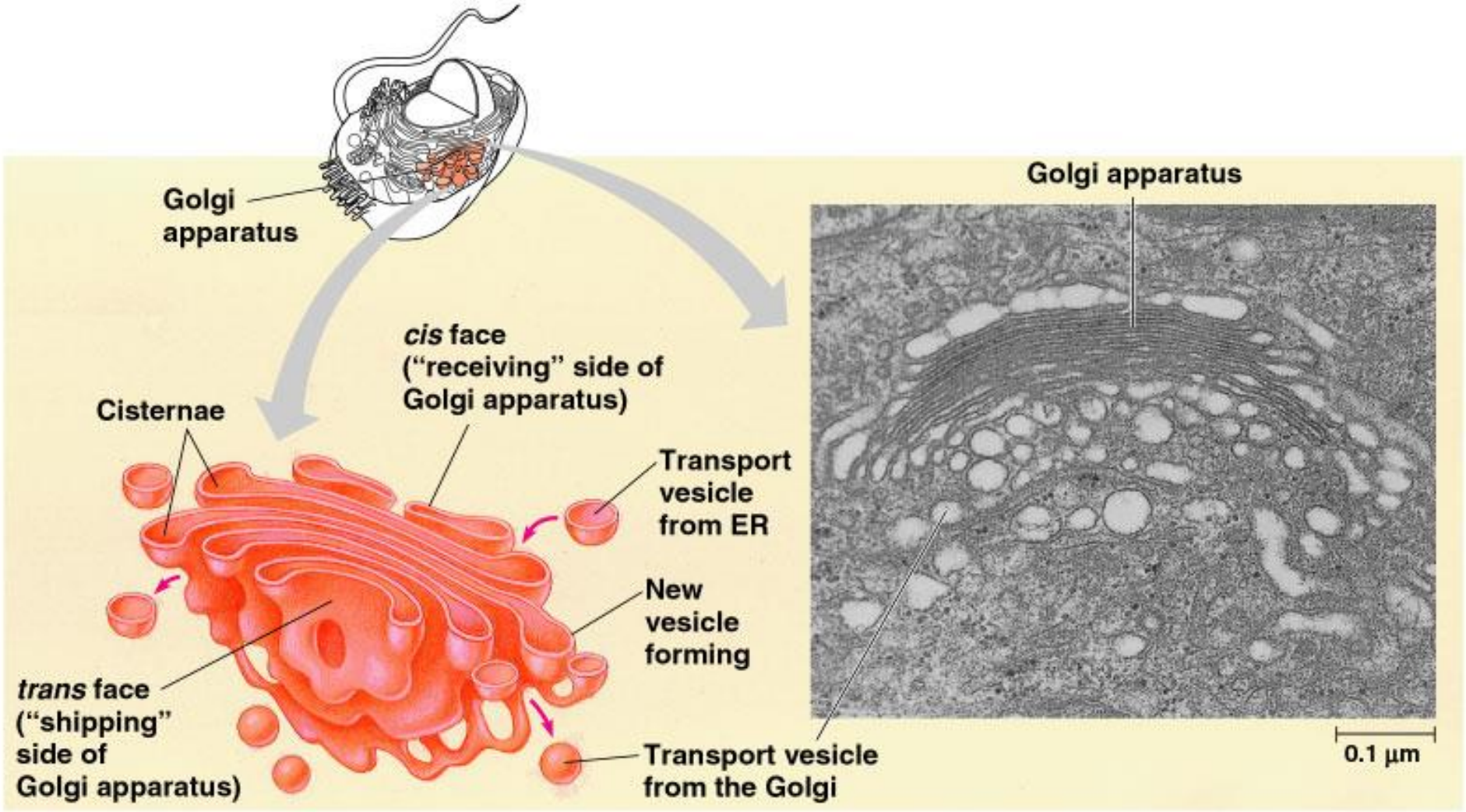





Copyright © 2007 Dennis Kunkel Microscopy, Inc. / Dennis Kunkel

# Golgi Apparatus (mail room)

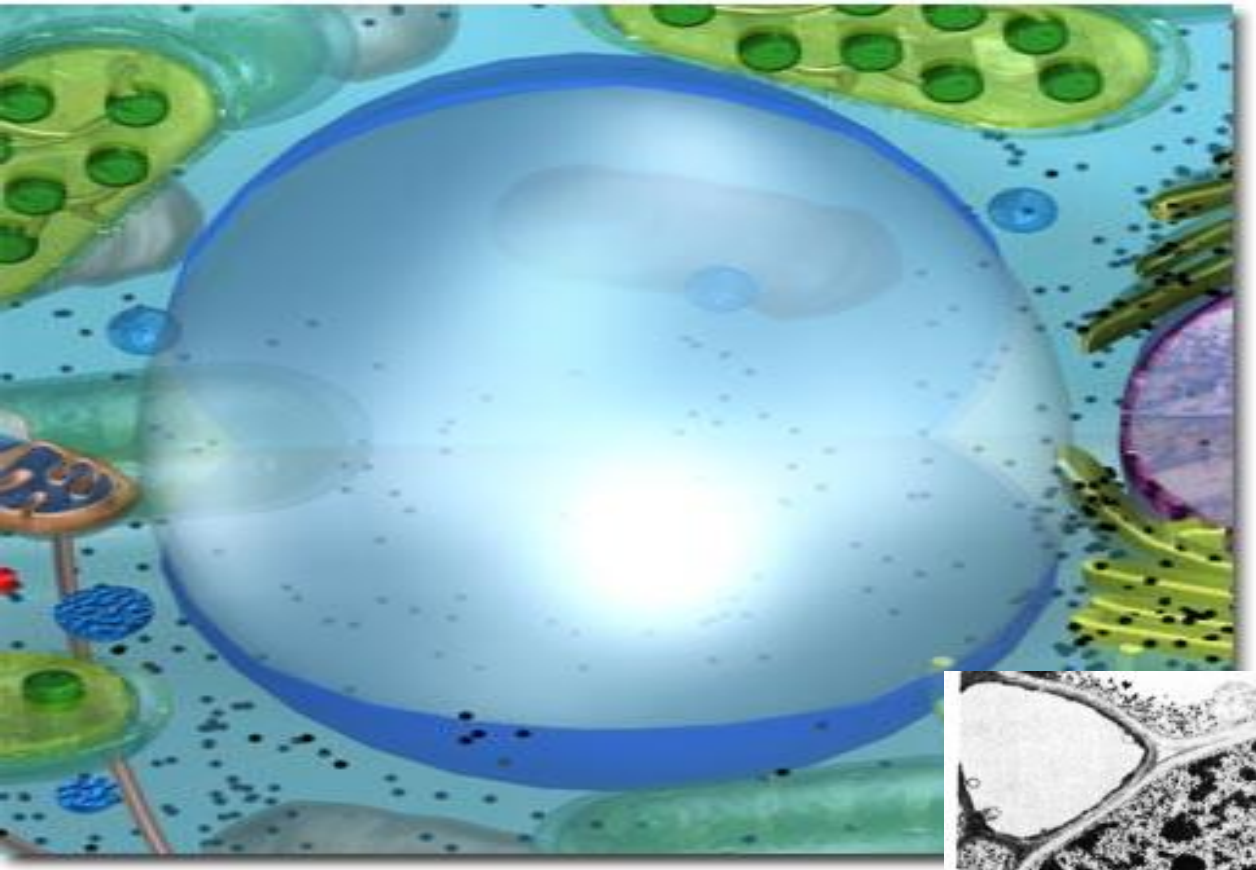
- Function: packages materials; creates vesicles (membrane sacs) that ship materials to other parts of the cell
  - –Stacked, flattened membranes

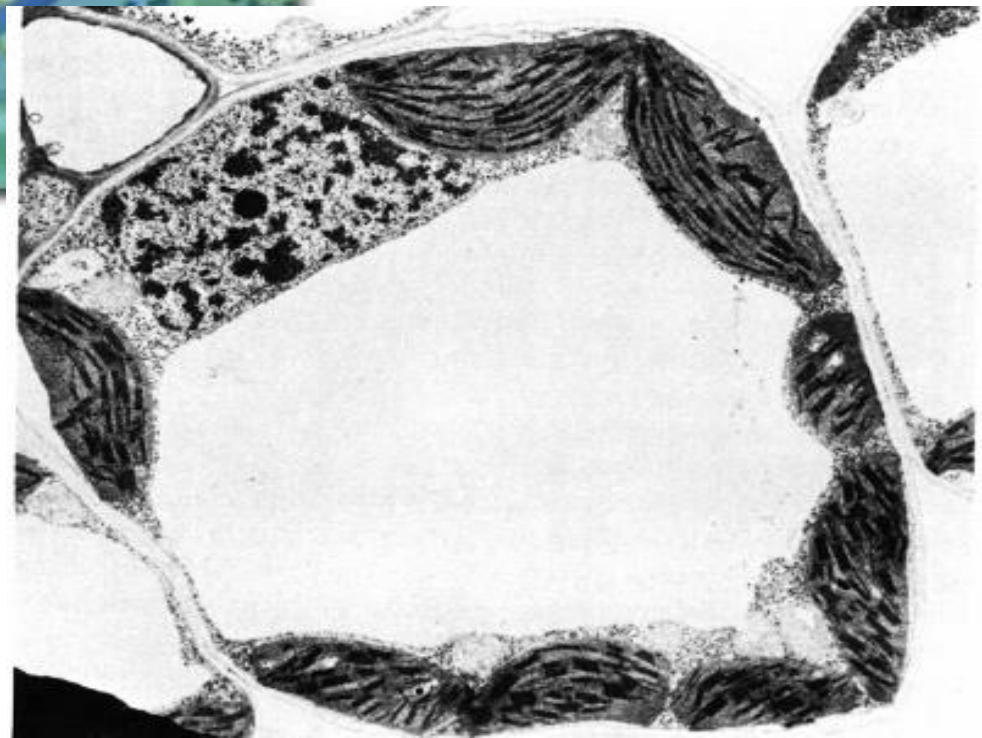


# Vacuoles (lockers)

- Function: storage (food, water, pigments, and waste)
  - –Plant cells have a very large vacuoles
  - –Types: food, contractile, and central vacuole

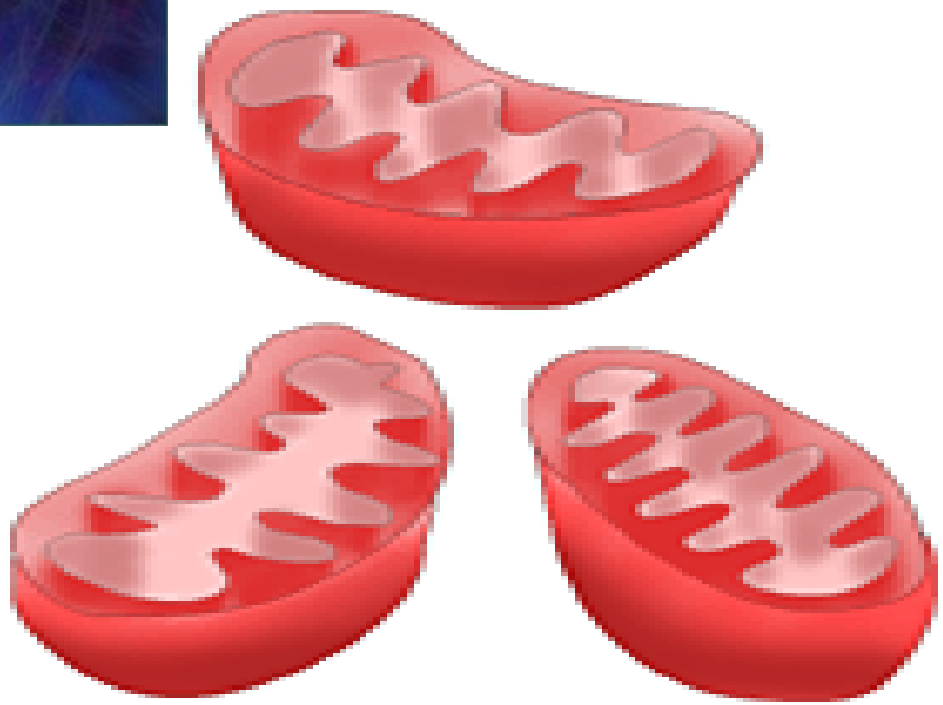
Plant Vacuole





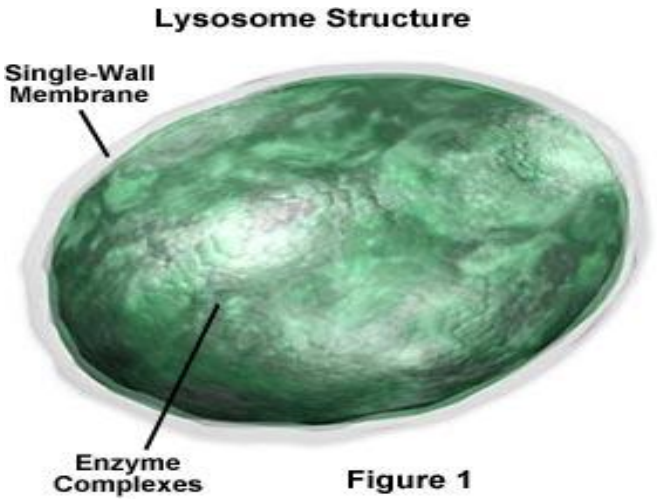
# Mitochondria (generator)

- Function: site of cell respiration to make energy (ATP) for the cell
  - Rod-shaped organelle with a double folded inner membrane



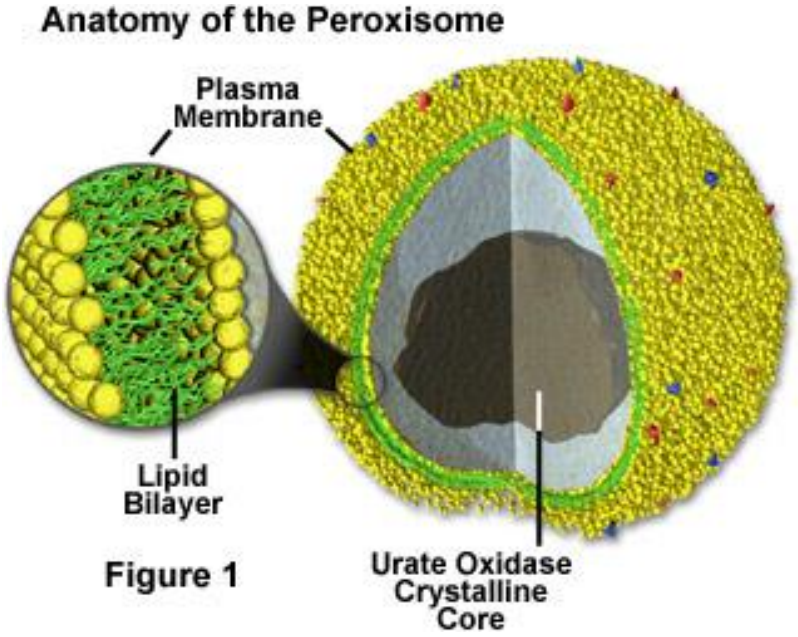
# Lysosomes (custodians)

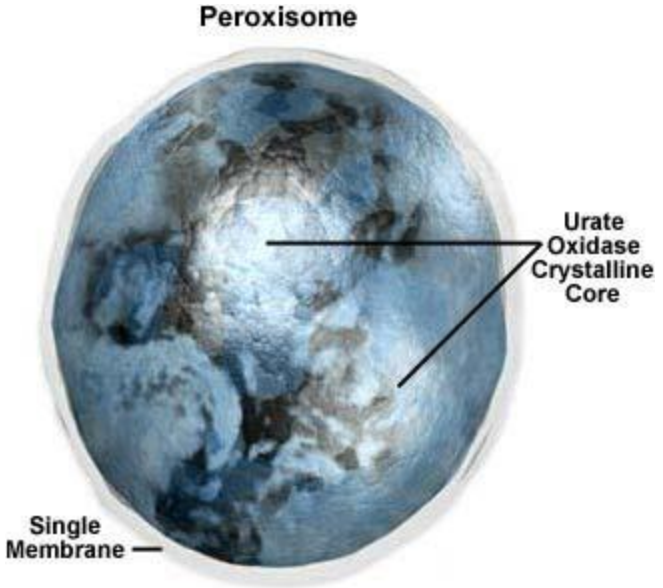
- Function: breaks down food, waste and dying organelles
  - –Small round organelles that contain digestive chemicals (enzymes)



# Peroxisomes

- Function: breaks down hydrogen peroxide and other toxins in the cell



# Centrioles

- Function: coordinates the division of the animal cells in Mitosis
  - –Only active during cell division
  - –Made up of cytoskeleton

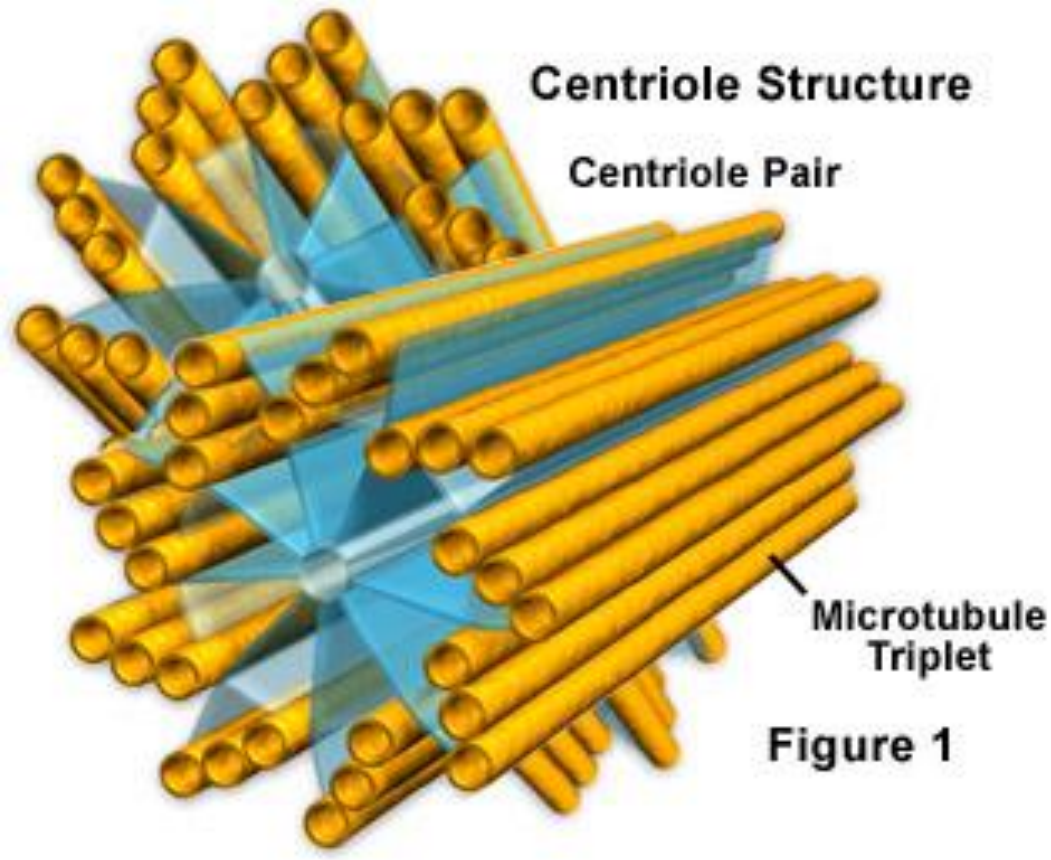
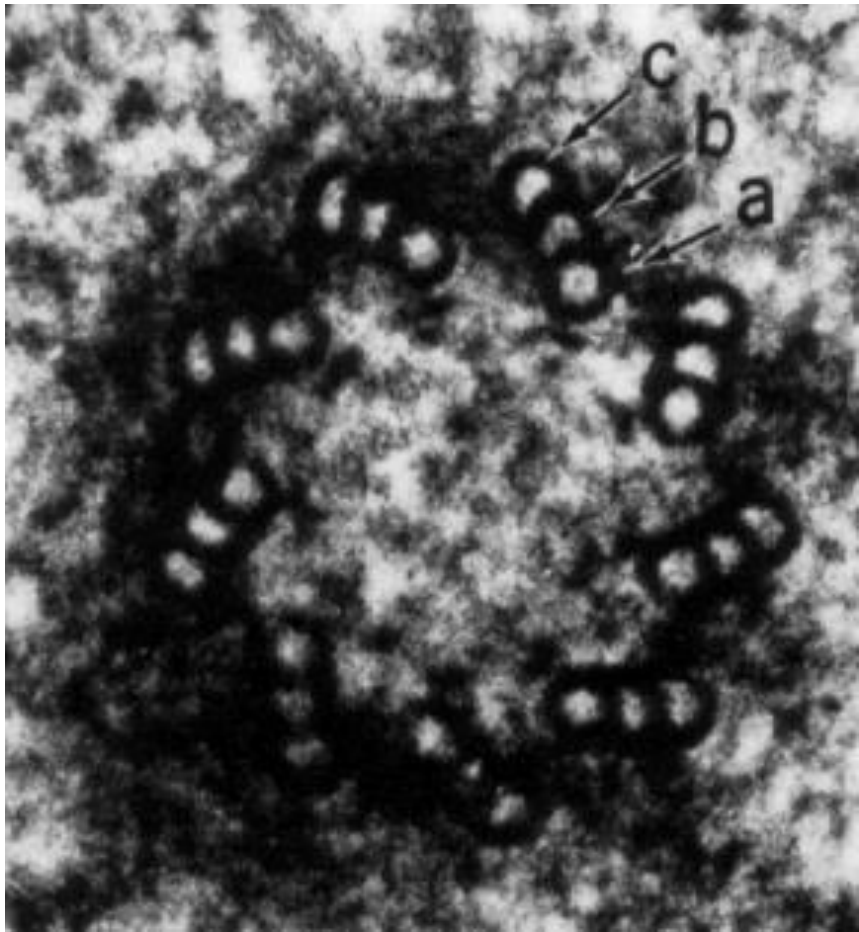

Centriole Structure
Centriole Pair
Microtubule
Triplet

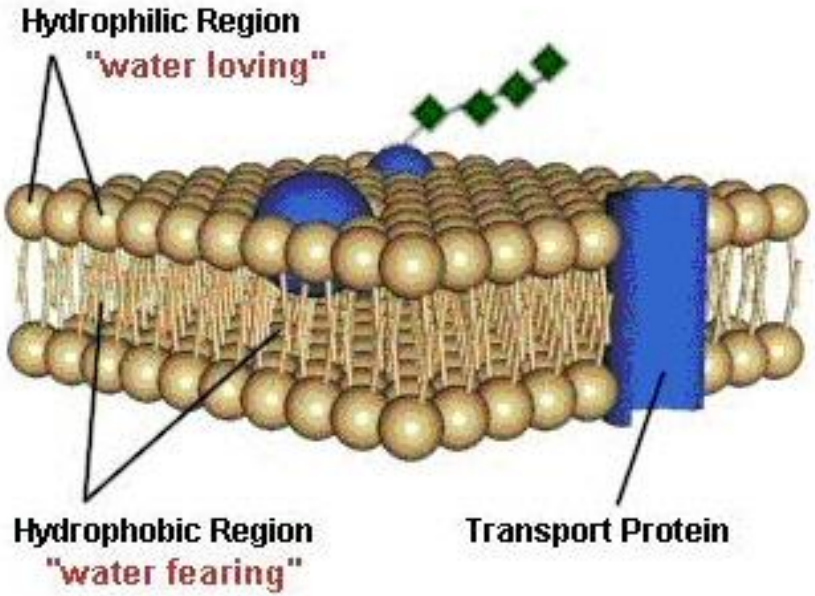
Figure 1

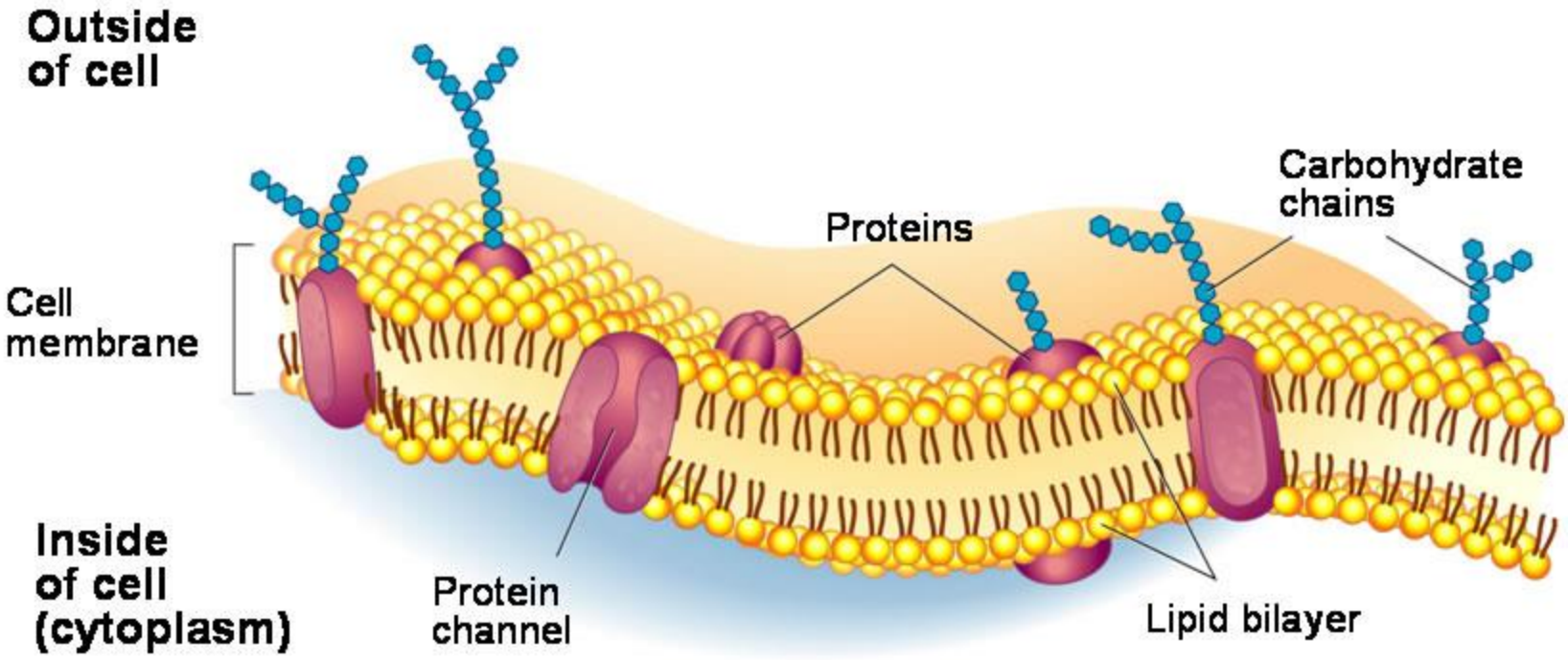

c
b
a

# Plasma (Cell) Membrane (outer walls and doors)

- Function: controls what substances come into and out of the cell
  - Made of a phospholipid bilayer

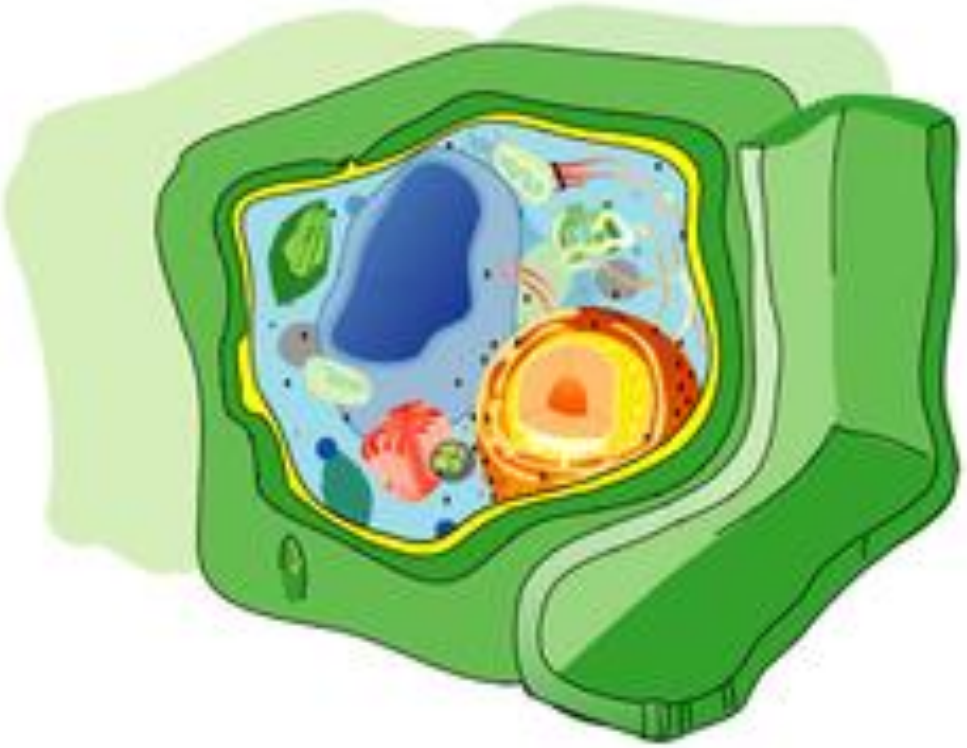
# Cell Membrane

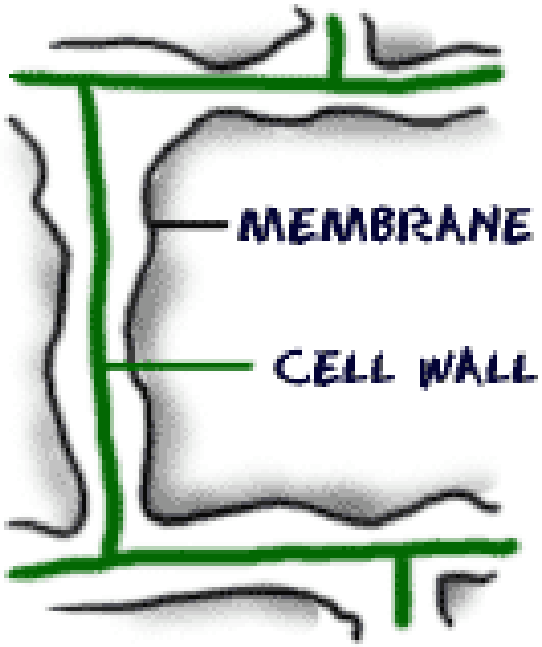


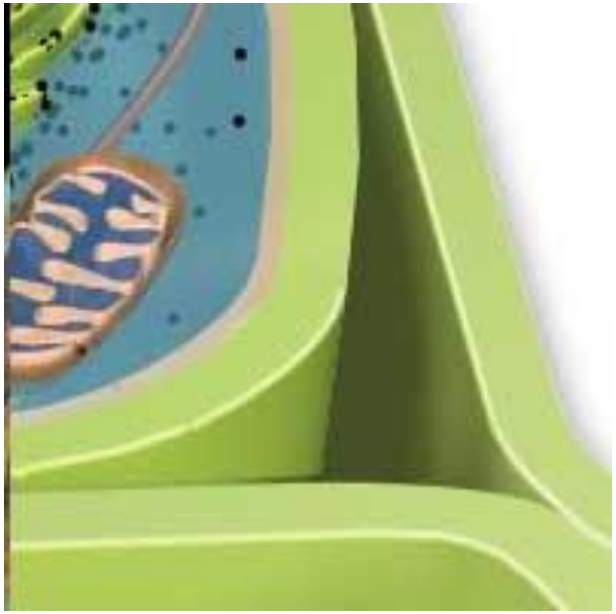



# Cell Wall (outer brick walls)

- Function: protects the cell from the outside and gives it shape
  - Strong, rigid wall
  - Plants, bacteria, fungi and some protists have Cell Walls




MEMBRANE
CELL WALL




00:02:08 ELAPSED

# Chloroplast (cafeteria)

- Part of a group of organelles called plastids
- Function: site of photosynthesis which makes glucose which is the cells food
  - Contain chlorophyll – green pigment that captures the sun's light.

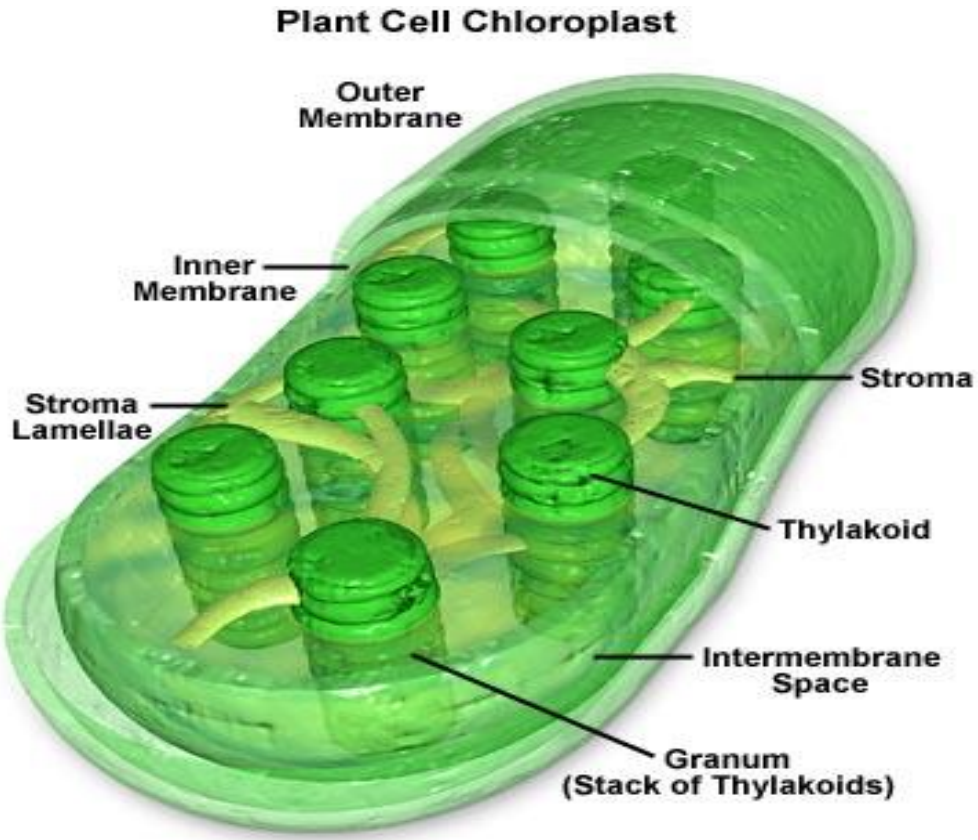

Plant Cell Chloroplast
Outer Membrane
Inner Membrane
Stroma
Stroma Lamellae
Thylakoid
Intermembrane Space
Granum (Stack of Thylakoids)

Figure 1

# Endomembrane System

- **Endomembrane system =** set of physically connected membranes and transfer connected organelles that carry out a variety of cell functions

- **Organelles:** Nucleus, endoplasmic reticulum, golgi apparatus, vesicles, lysosomes, vacuole, and plasma (cell) membrane

THE END