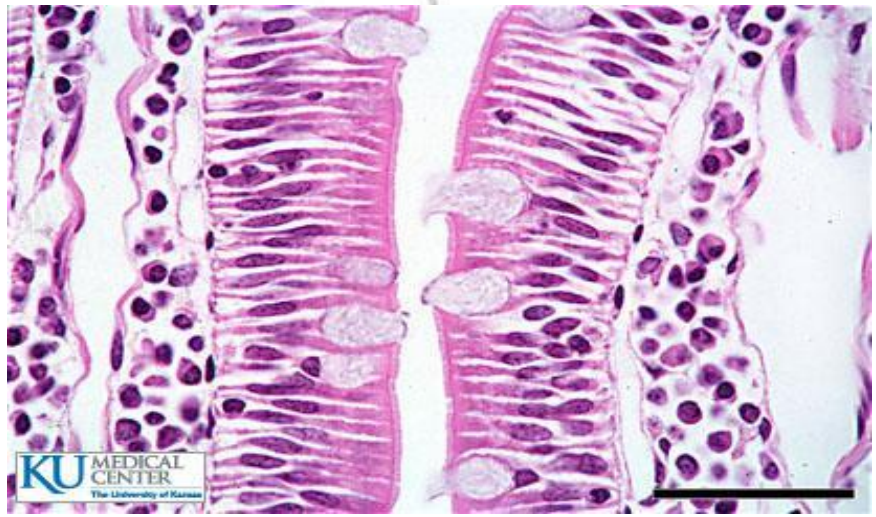

# Unit 2: Cells

Bio 2- Human Biology

# Cells vary in SIZE and STRUCTURE

Depends on what they do

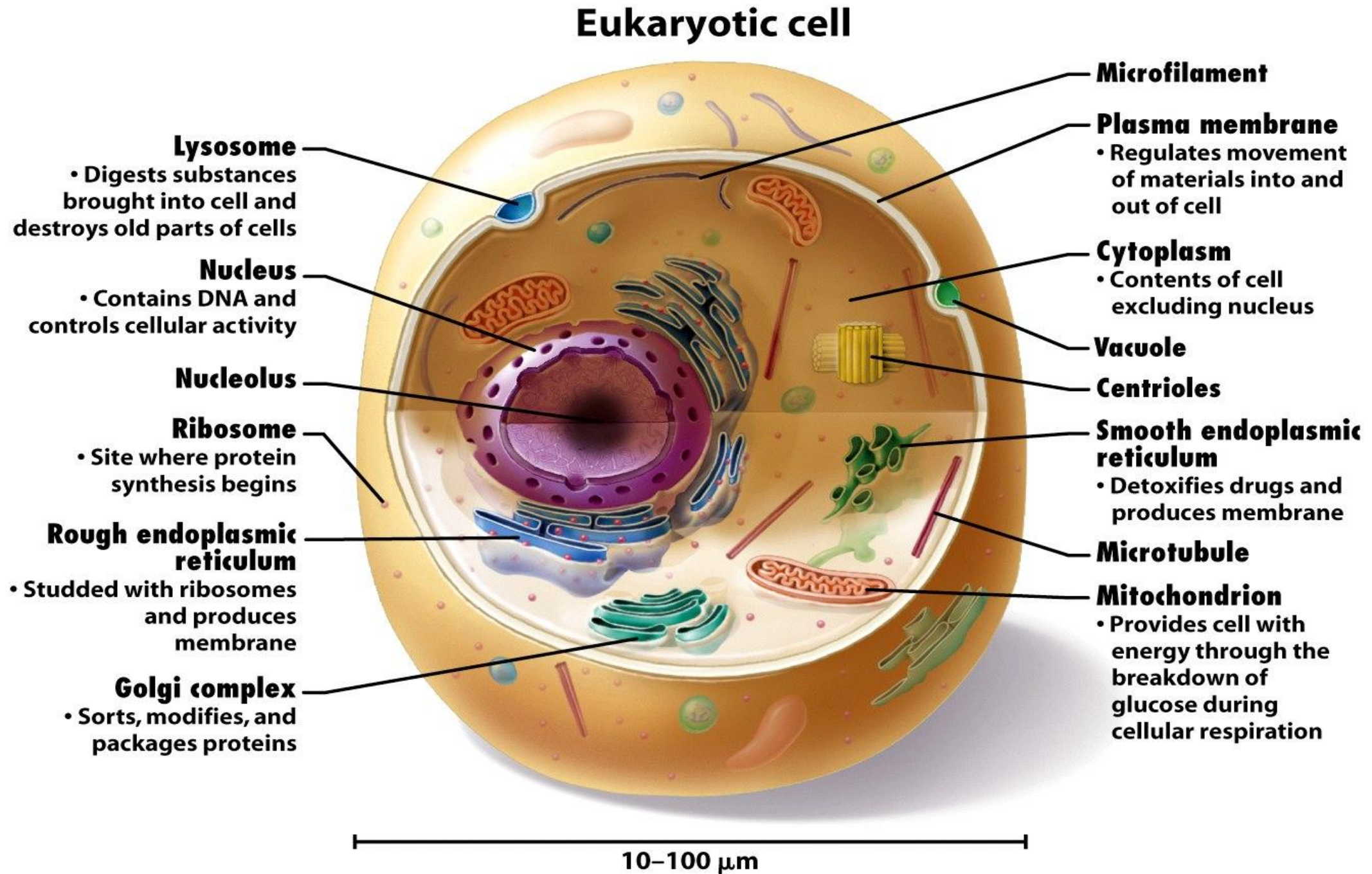



# Cytology Objectives

**You should be able to understand, identify, label, explain, etc**:

-A. Features/Organelles of a Eukaryotic- Animal Cell
-B. Movement across the cell membrane (Cell Transport)
-C. How cells get energy (Cellular Respiration)
-D. How are proteins made (Protein Synthesis)
-E. Advancements in medicine (Stem Cells)
-F. How do we see them?! (Microscope)

# **Eukaryotic** vs. Prokaryotic



# Eukaryotic vs. **Prokaryotic**

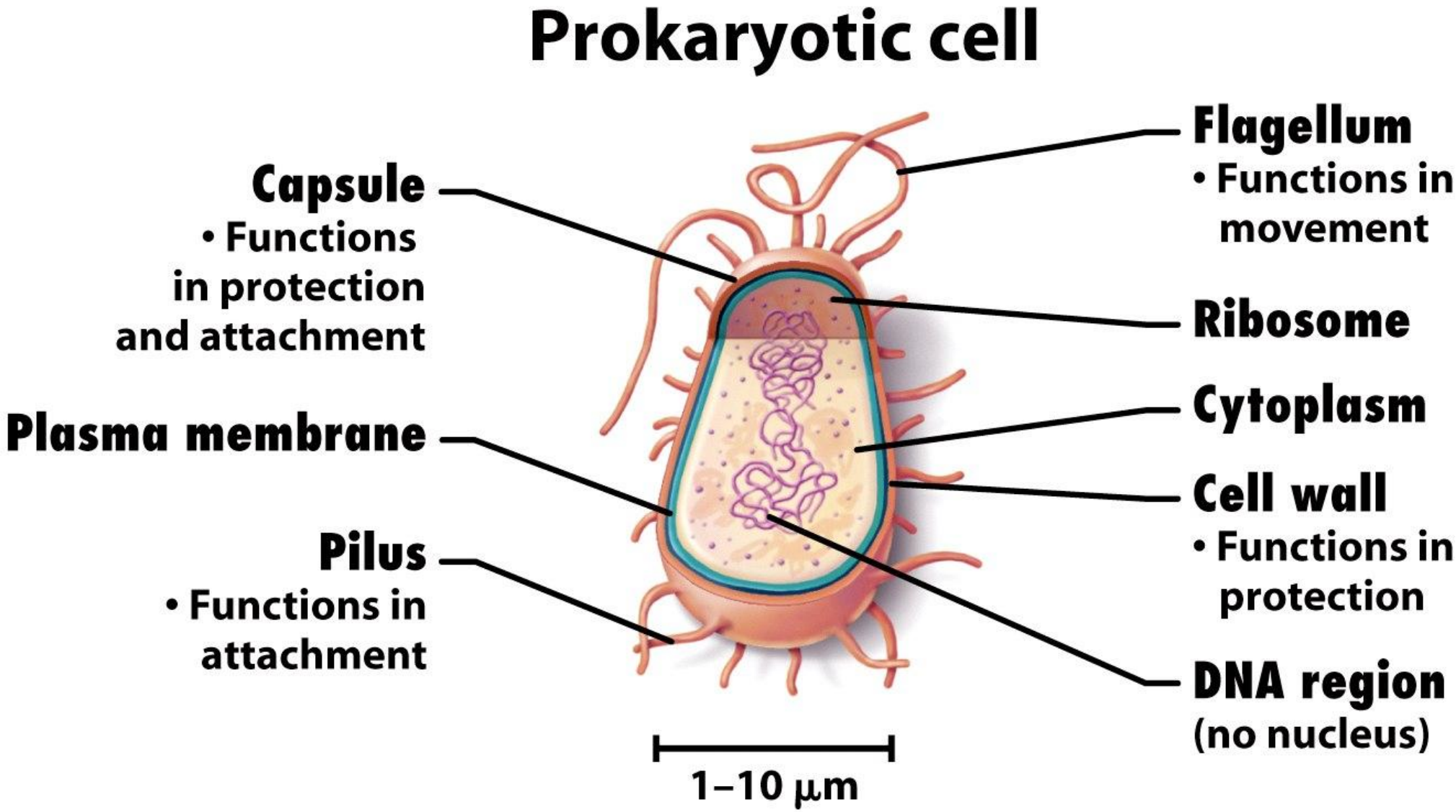
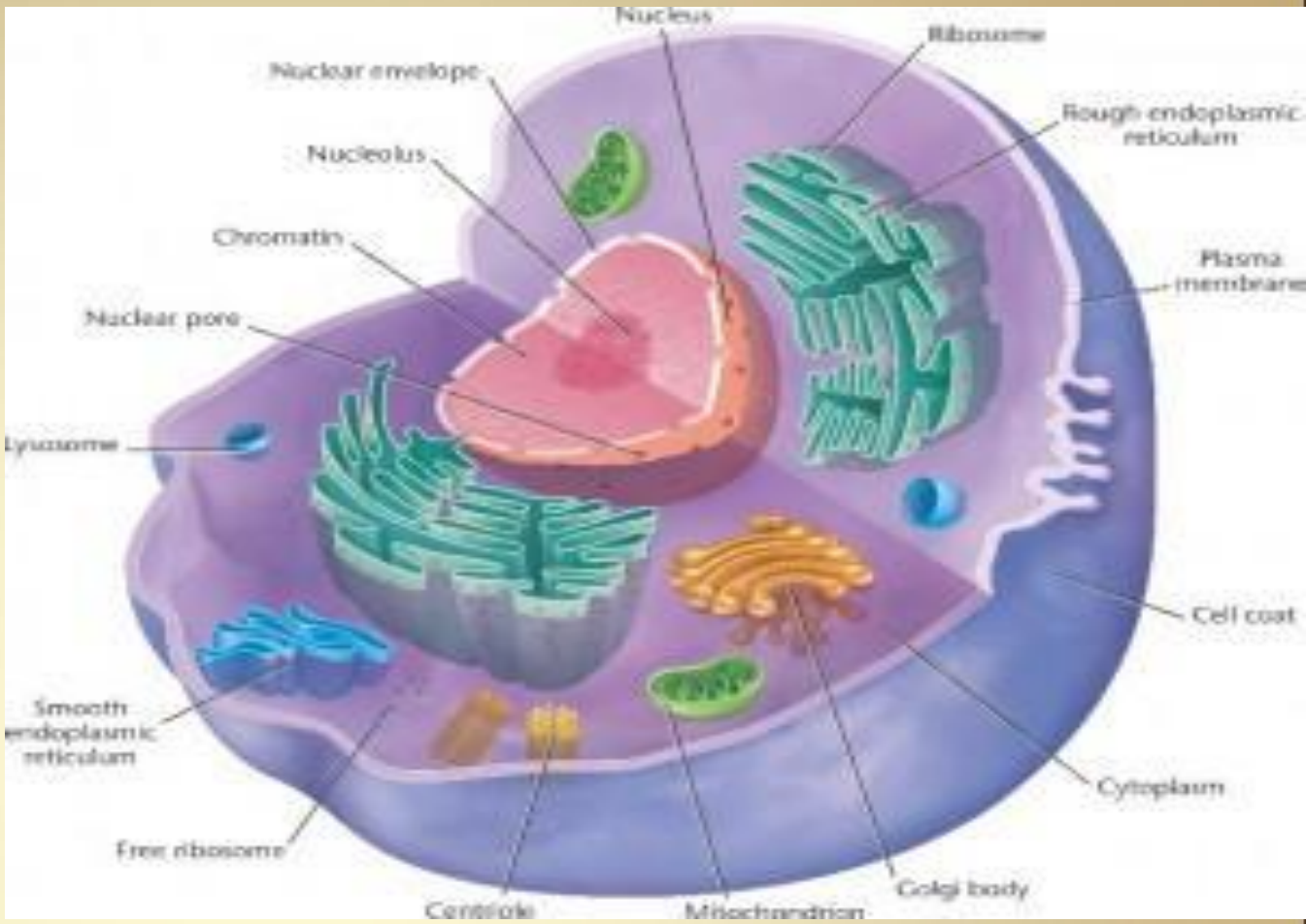



Figure 3-2 part 1 Biology of Humans, 2/e

# CYTOLOGY




All Eukaryotic-Animal Cells have:

- Nucleus
- Cytoplasm (cytosol)
- Cell Membrane
- Lots of membrane-bound organelles

# A. Cell Features:

ORGANELLES- "little organs" within the cell that perform specific functions

The nucleus is to the cell what the _____is to a person.

The cell membrane is to a cell what the _____ is to a person.

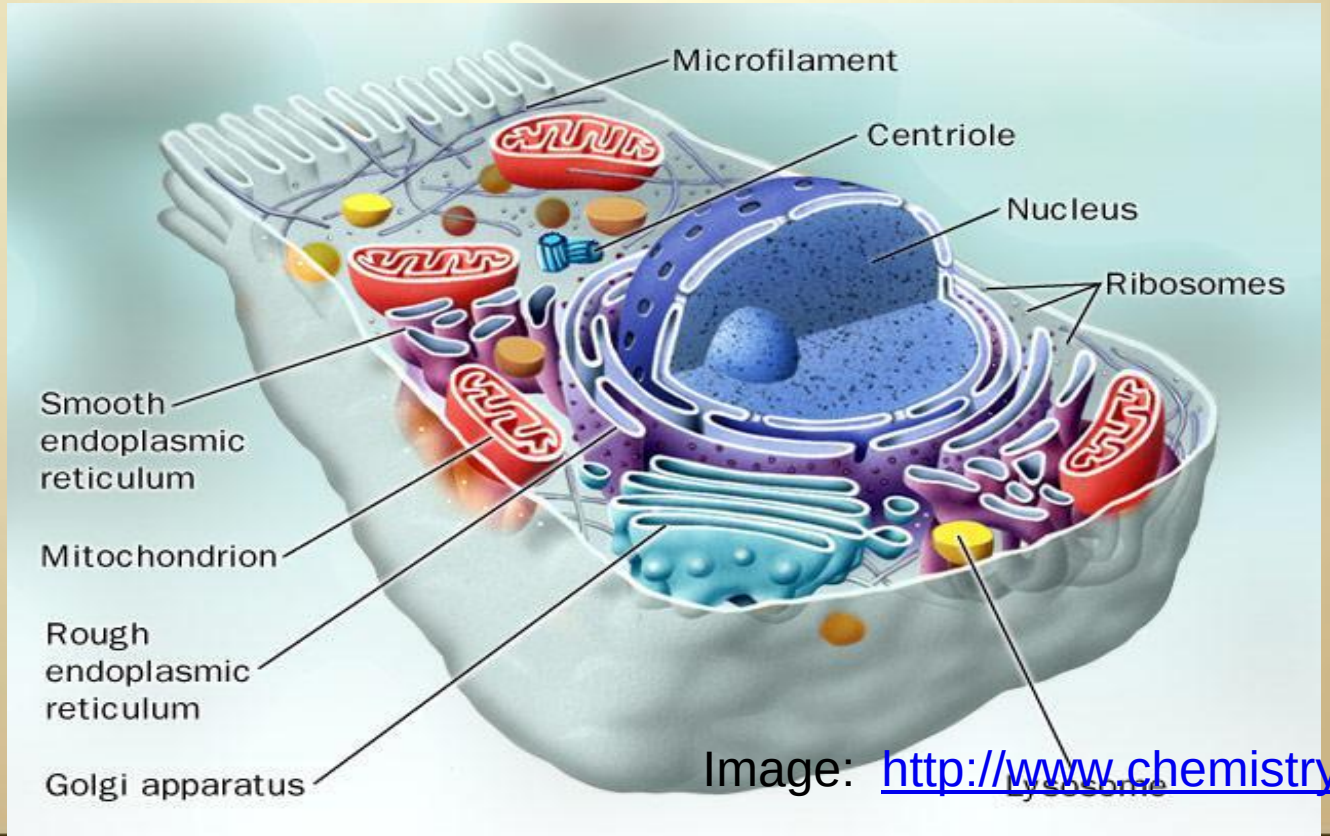



Image: http://www.chemistrypictures.org

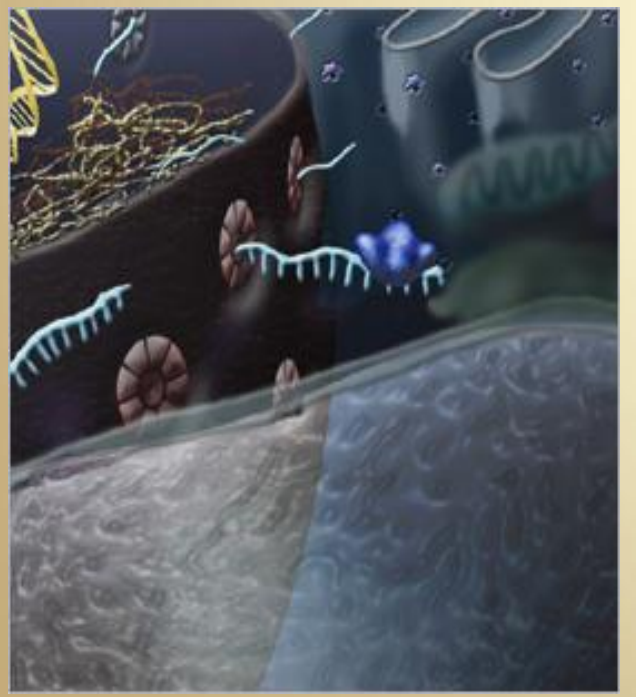
# TABLE 3.4 REVIEW OF MAJOR ORGANELLES AND THEIR FUNCTIONS

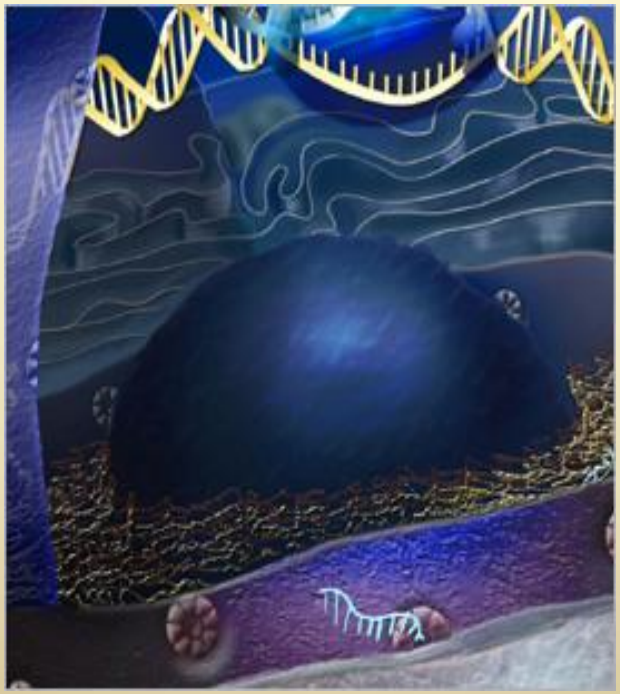
| ORGANELLE | FUNCTION |
|---|---|
| Nucleus | Contains almost all the genetic information and influences cellular structure and function |
| Rough endoplasmic reticulum (RER) | Studded with ribosomes (sites where the synthesis of proteins begins); produces membrane |
| Smooth endoplasmic reticulum (SER) | Detoxifies drugs; produces membrane |
| Golgi complex | Sorts, modifies, and packages products of RER |
| Lysosomes | Digest substances imported from outside the cell; destroy old or defective cell parts |
| Mitochondria | Provide cell with energy through the breakdown of glucose during cellular respiration |

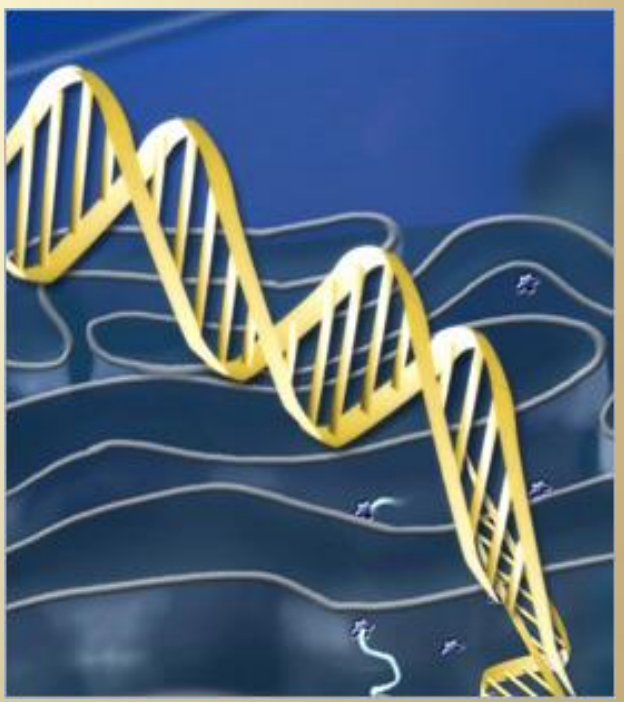
Table 3-4 Biology of Humans, 2/e

# Cell Nucleus

- Directs cell activities (the “brain” of the cell)
- Contains genetic information (DNA) in the form of chromatin
- Also contains a nucleolus – makes ribosomes
- Surrounded by a nuclear envelope
- Has tiny pores where RNA can exit the nucleus







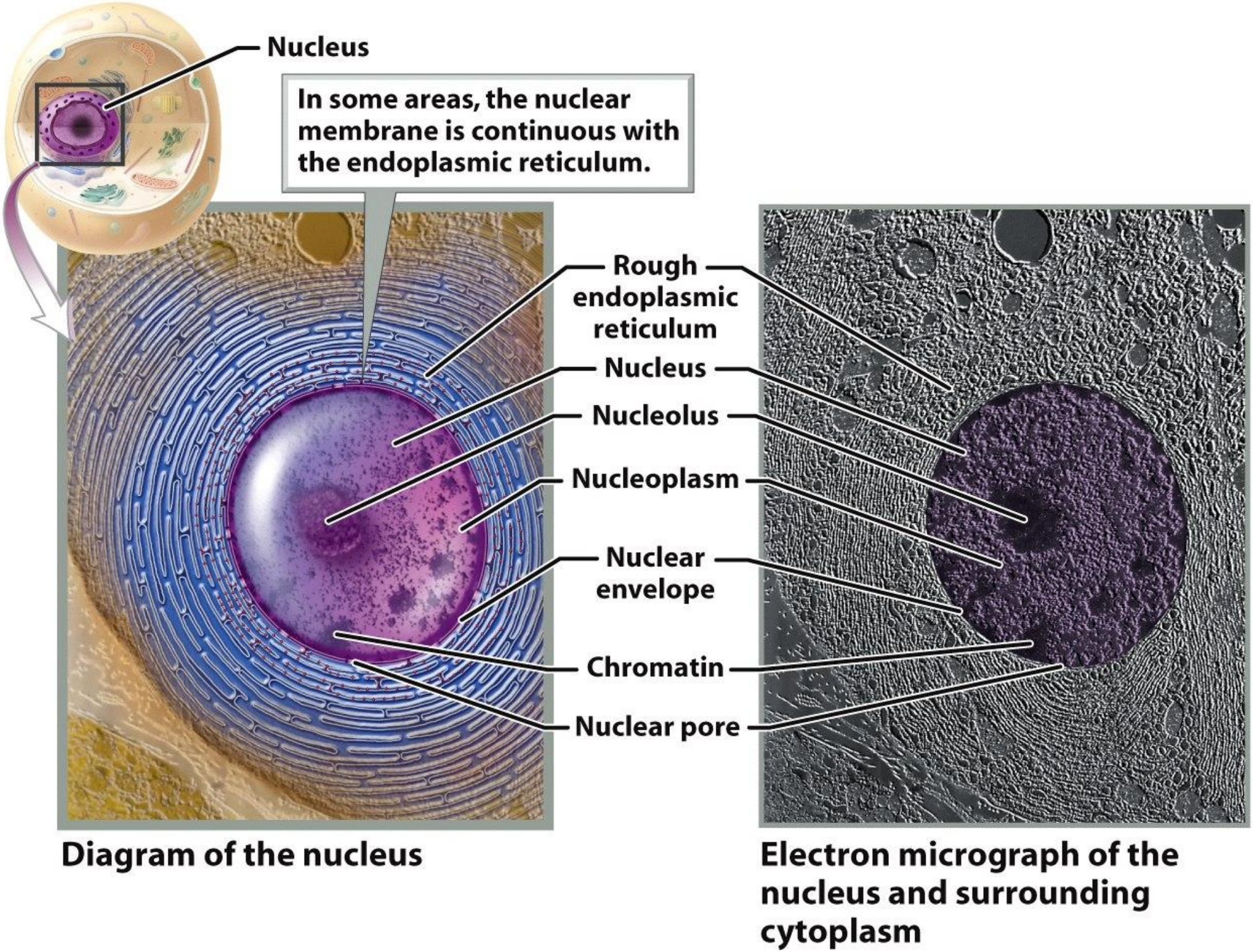



Figure 3-13 Biology of Humans, 2/e

# Chromosomes

**Individual chromosomes are visible during cell division when they shorten and condense.**

Figure 3-14a Biology of Humans, 2/e

**At all other times, the chromosomes are extended and not readily visible. In this dispersed state, the genetic material is called chromatin.**

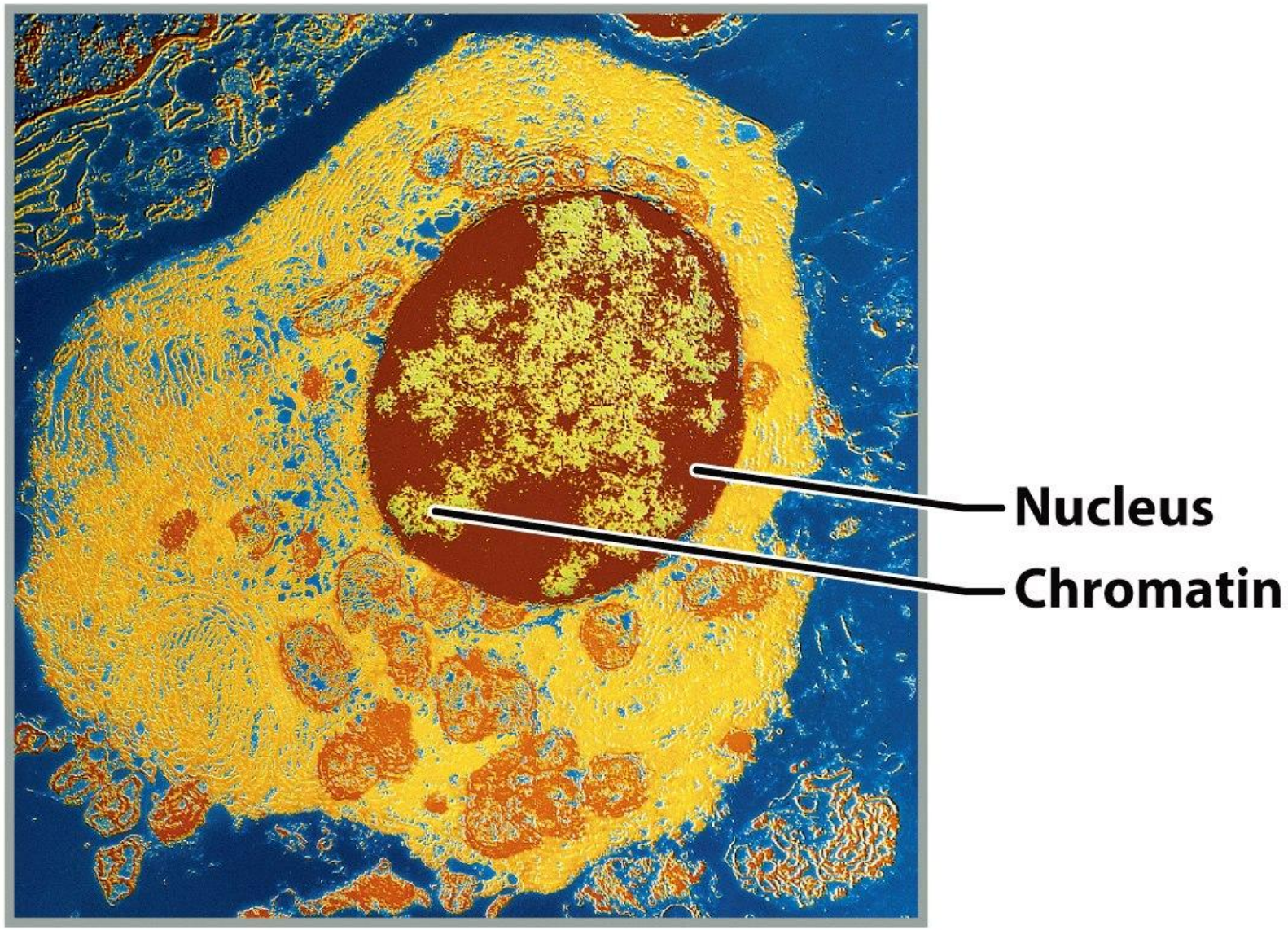
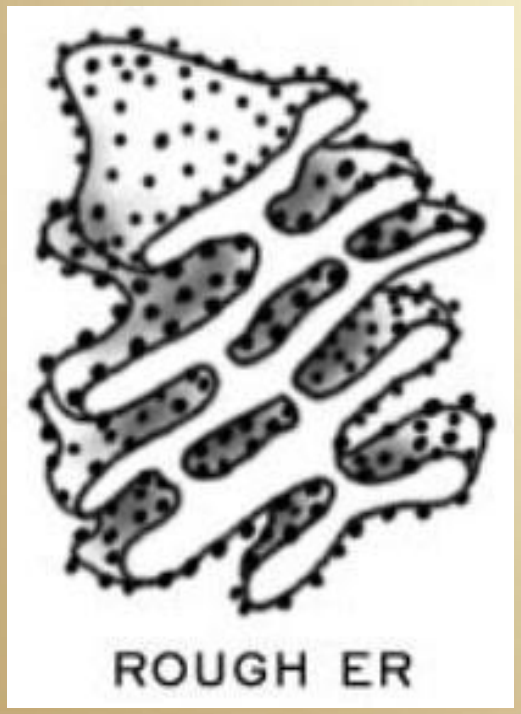


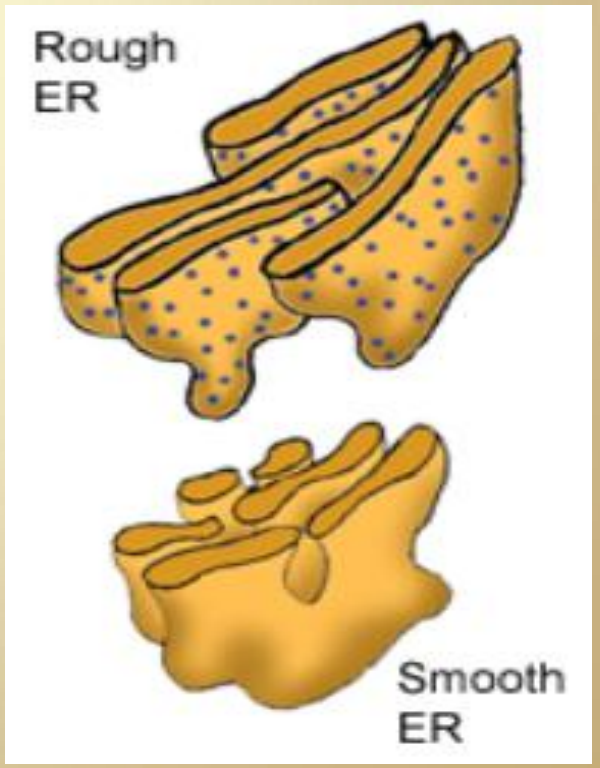

Figure 3-14b Biology of Humans, 2/e

# Endoplasmic Reticulum

- Transport system; canals and channels that connect membrane to nucleus and to organelles within the cell

- Smooth ER (lipid synthesis and detoxification)
- Rough ER (contains ribosomes for protein manufacture)



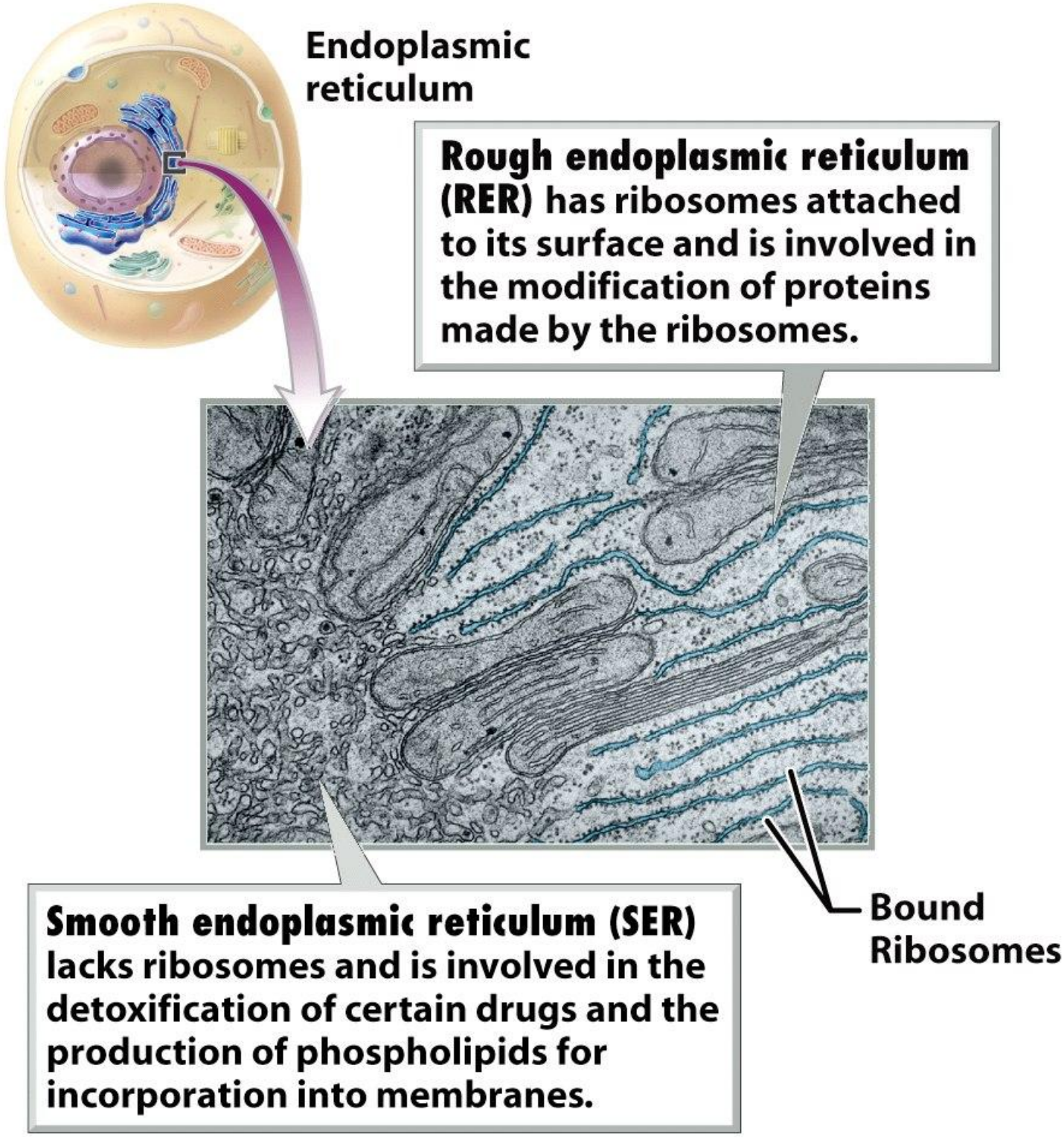
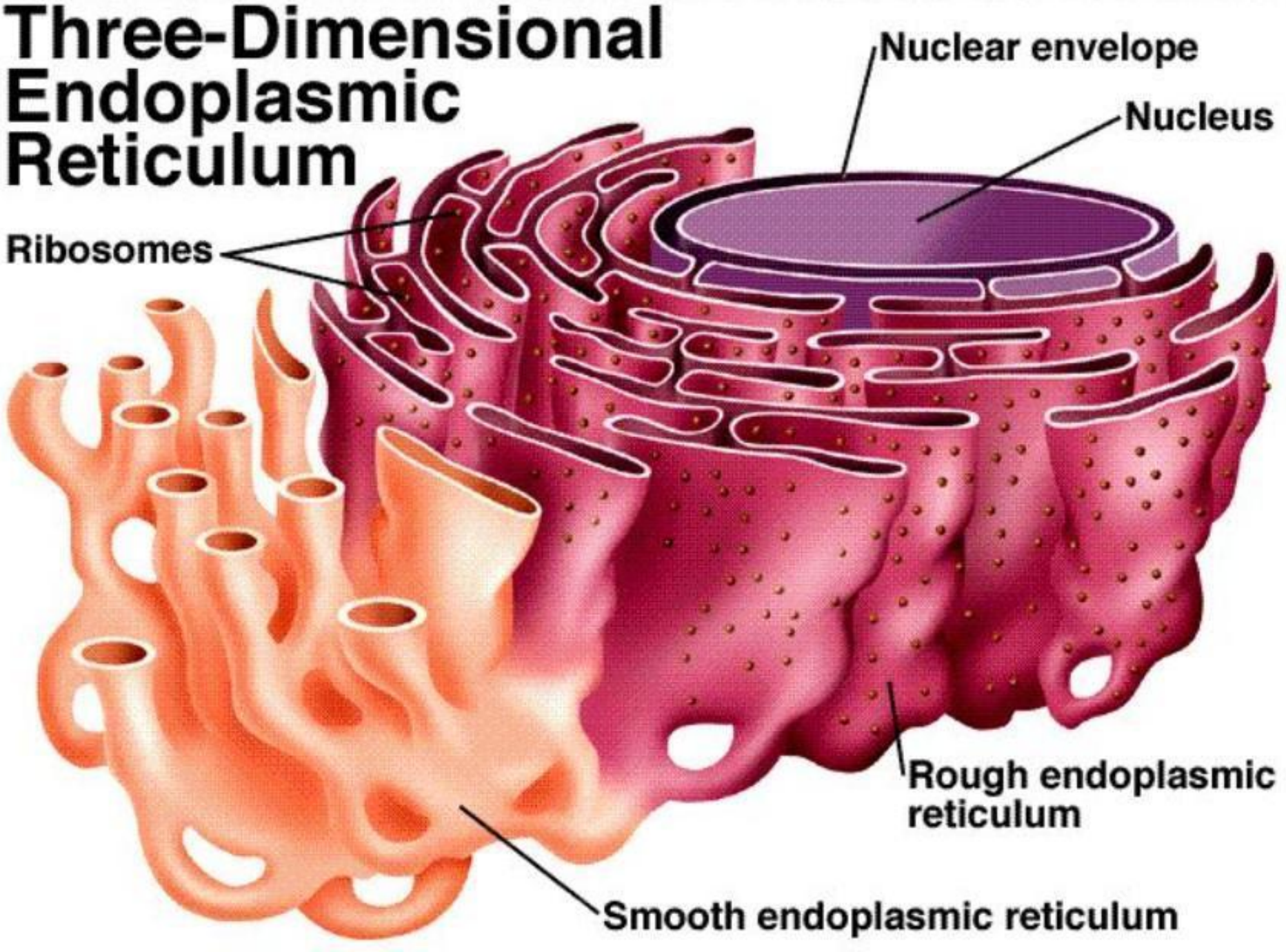


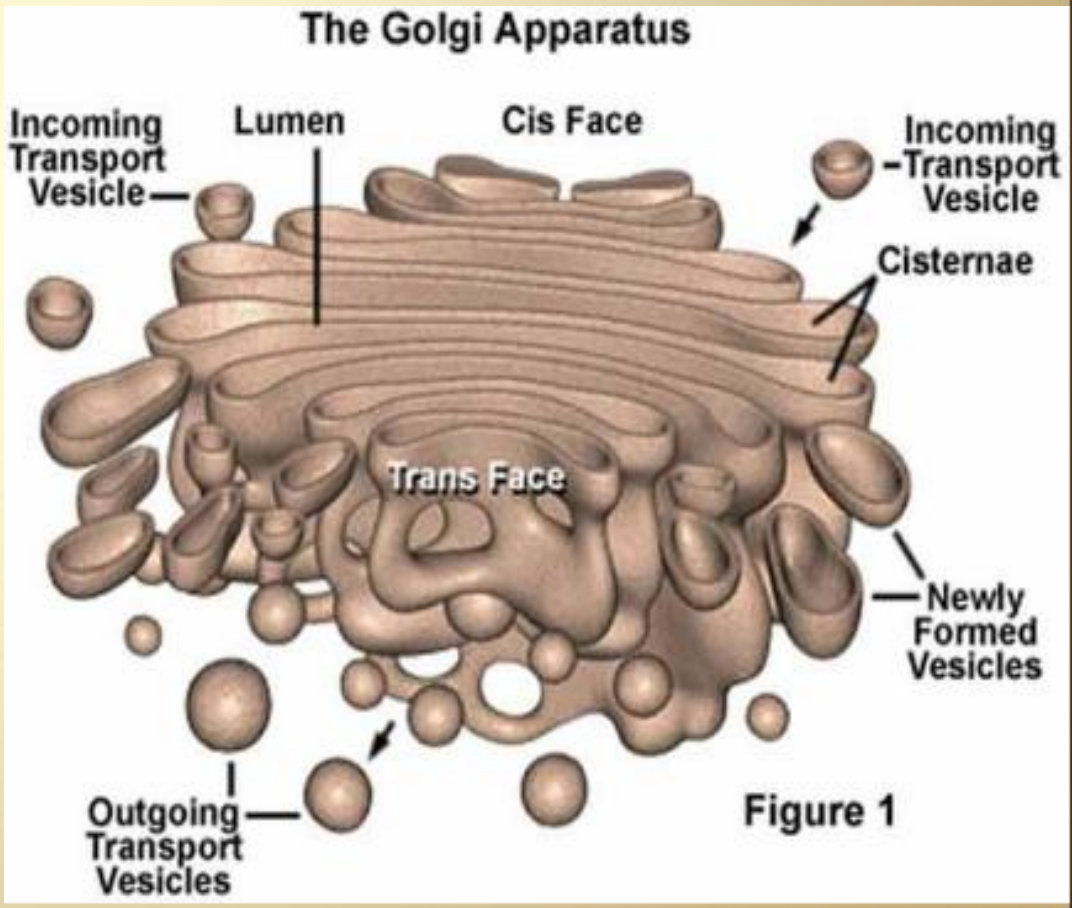

Figure 3-15 Biology of Humans, 2/e

# Three-Dimensional Endoplasmic Reticulum



# Golgi Apparatus

- Flattened membranes; function to package and deliver proteins produced by the ribosomes
- Proteins are exported in vesicles



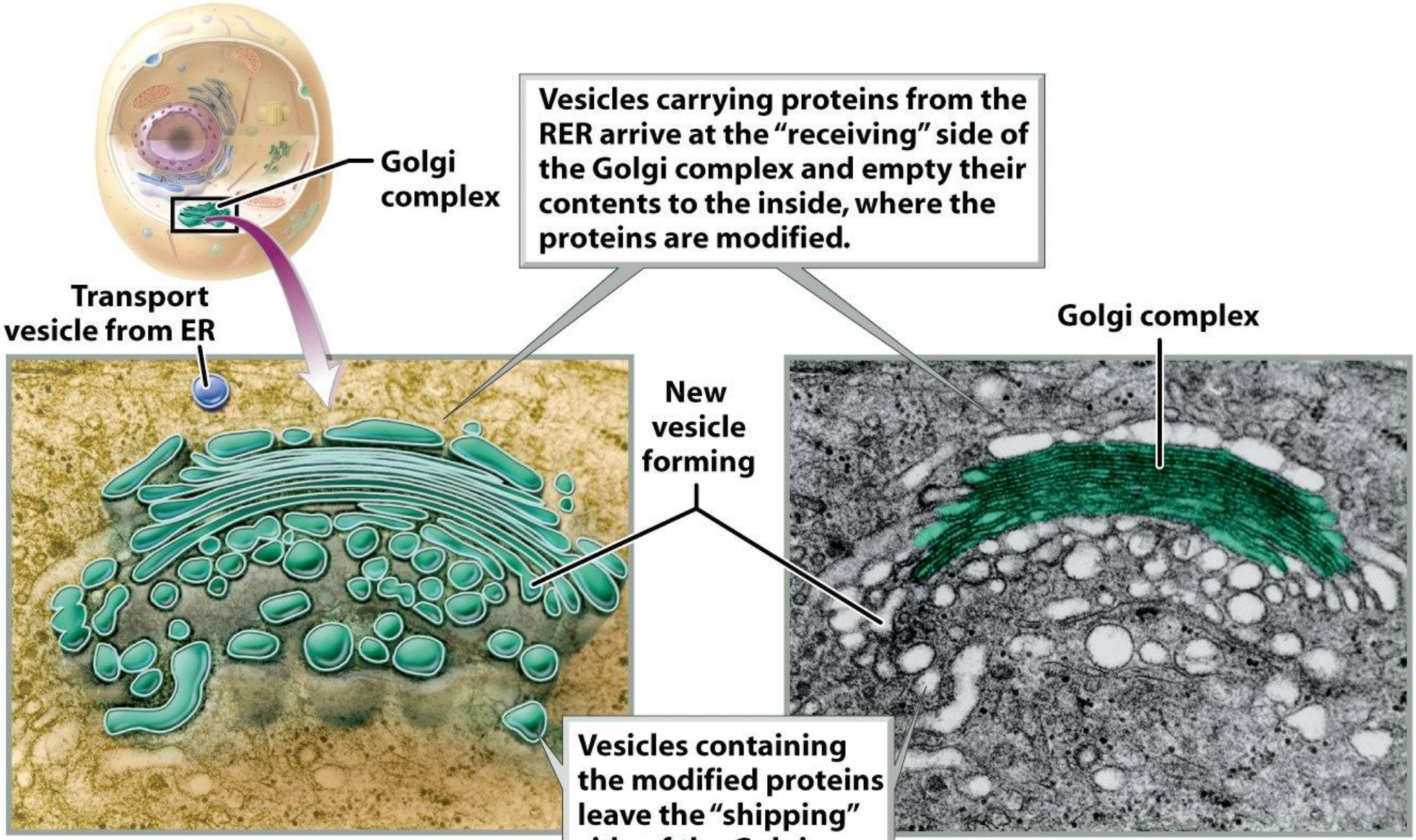



Figure 3-16 Biology of Humans, 2/e

# **Lysosomes** contain enzymes that breakdown macromolecules, diseased cells, and invaders

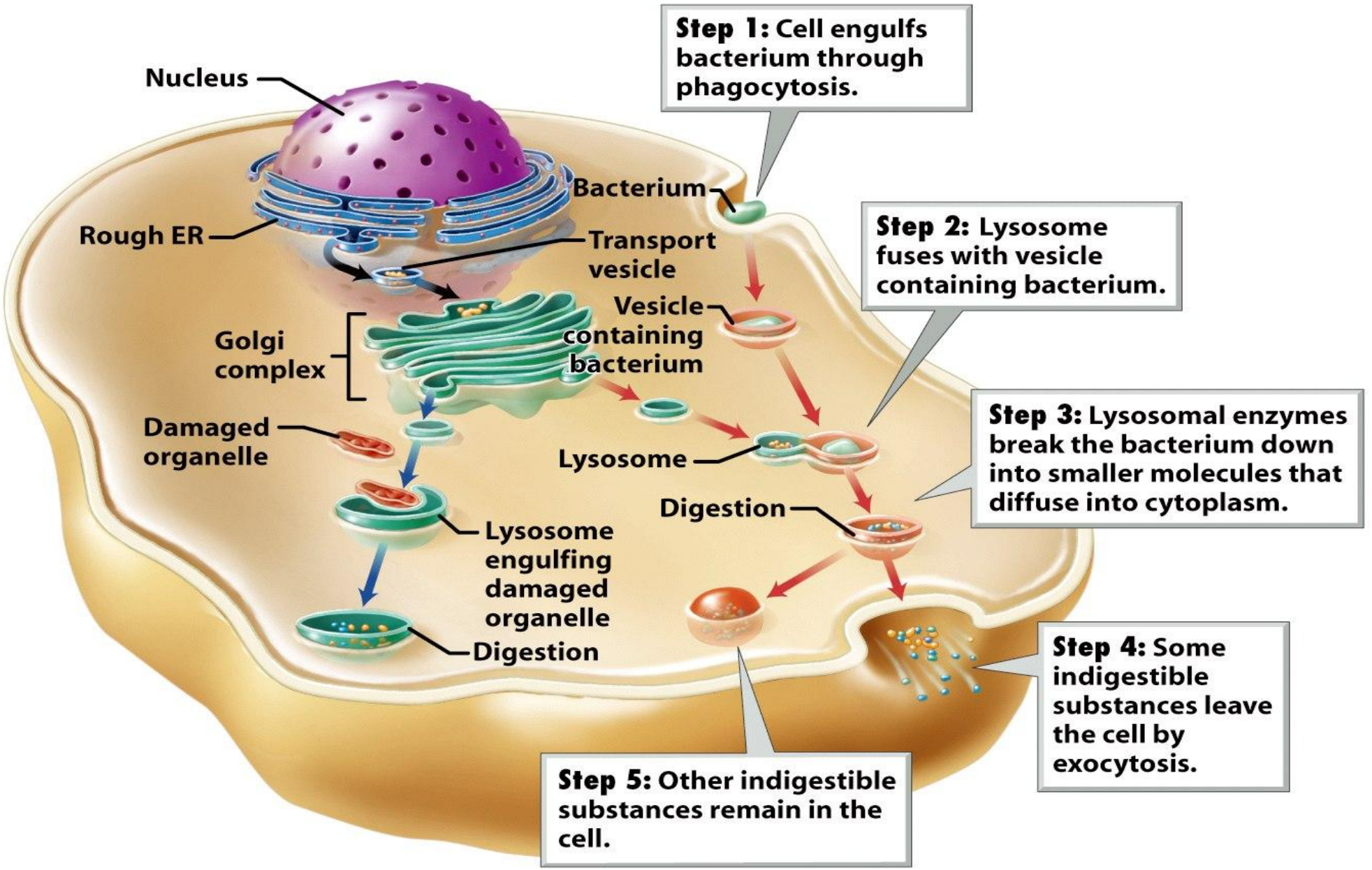
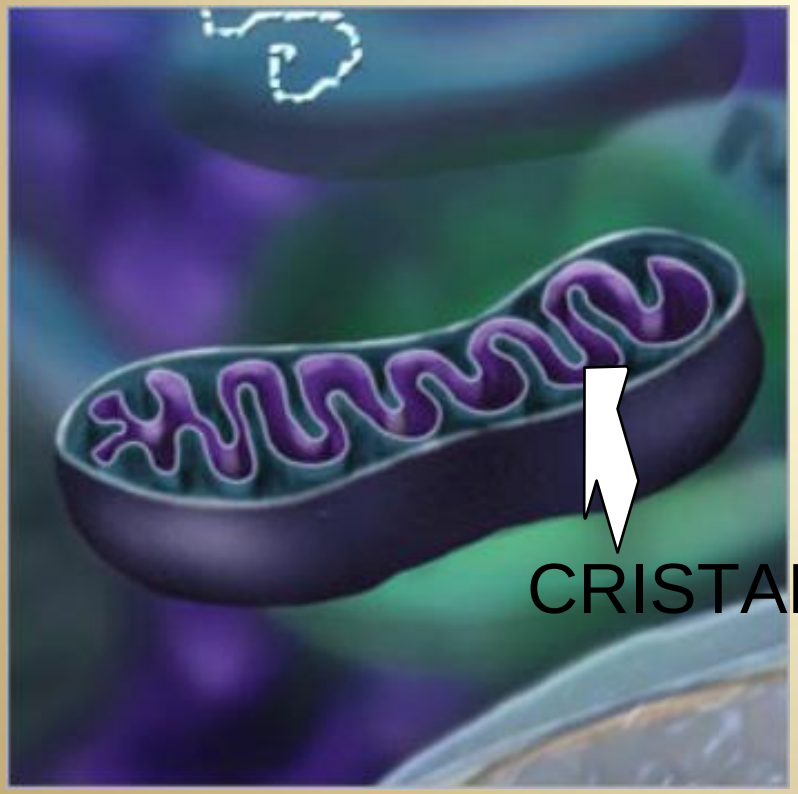



Figure 3-17 Biology of Humans, 2/e

# Mitochondria

- Chemical energy from food is converted to a useable form (ATP) • process is called Cellular Respiration
- The “powerhouse” of the cell



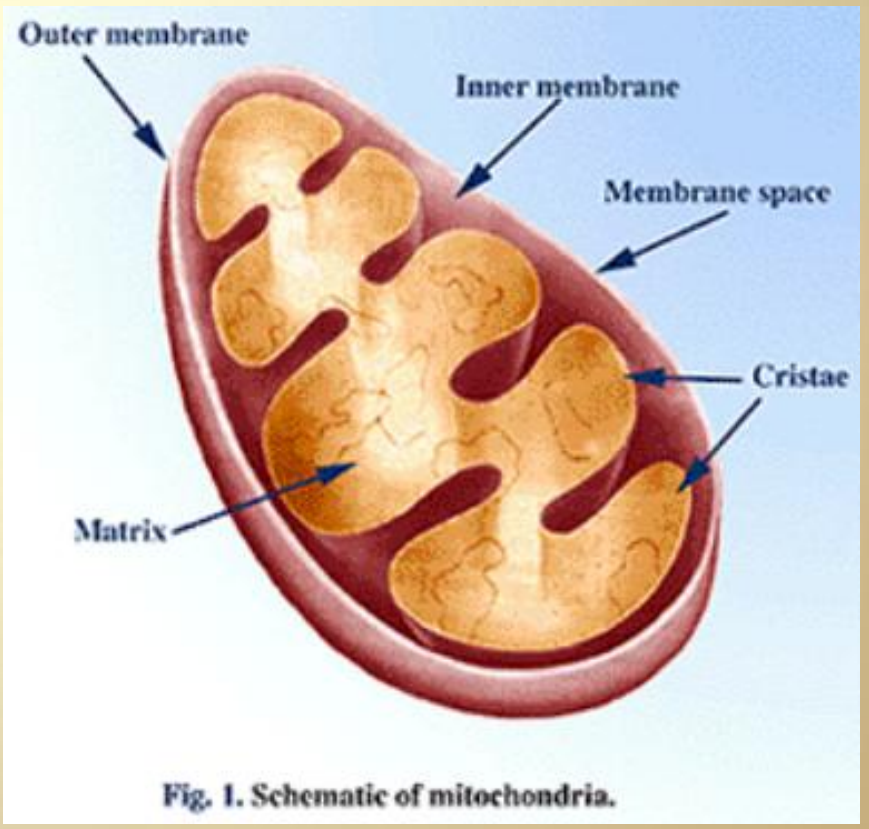
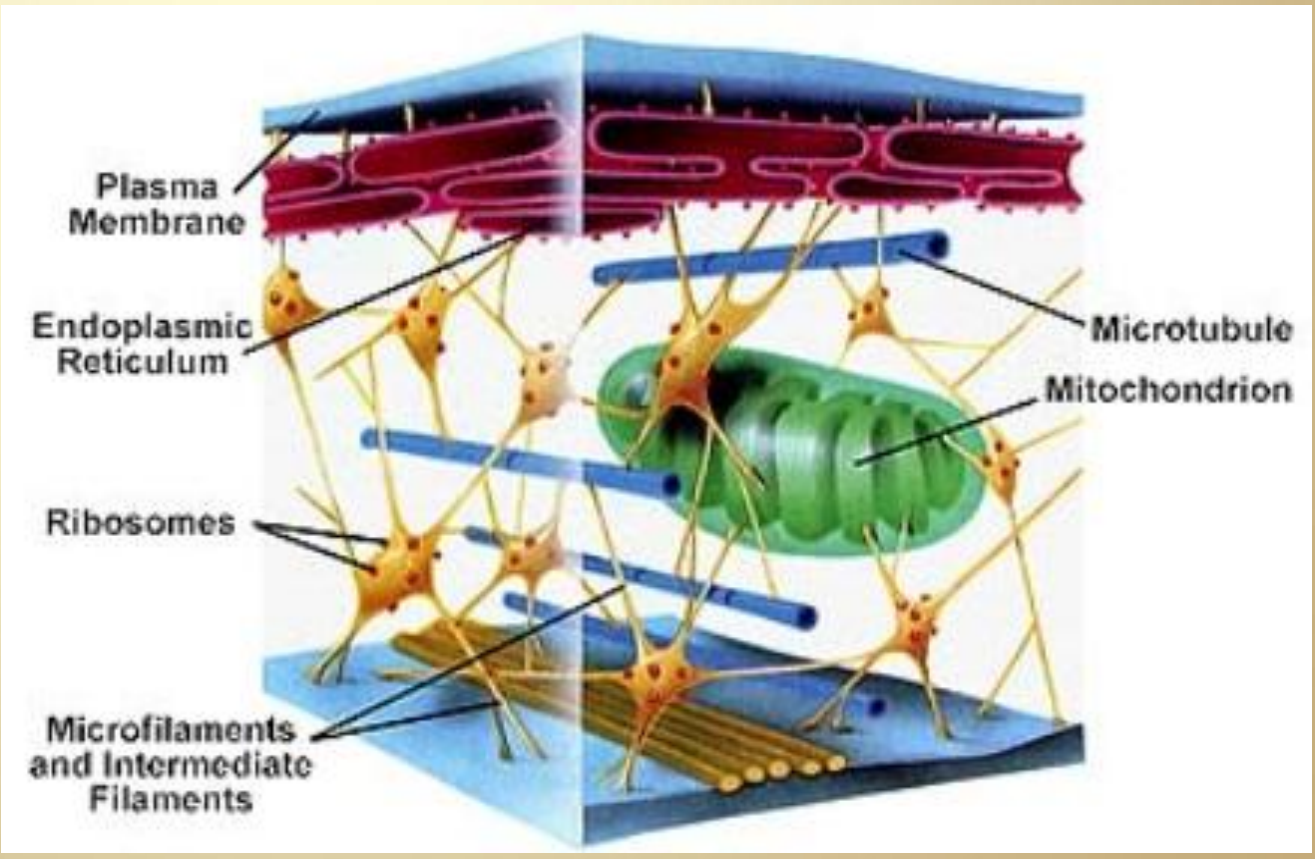



Fig. 1. Schematic of mitochondria.

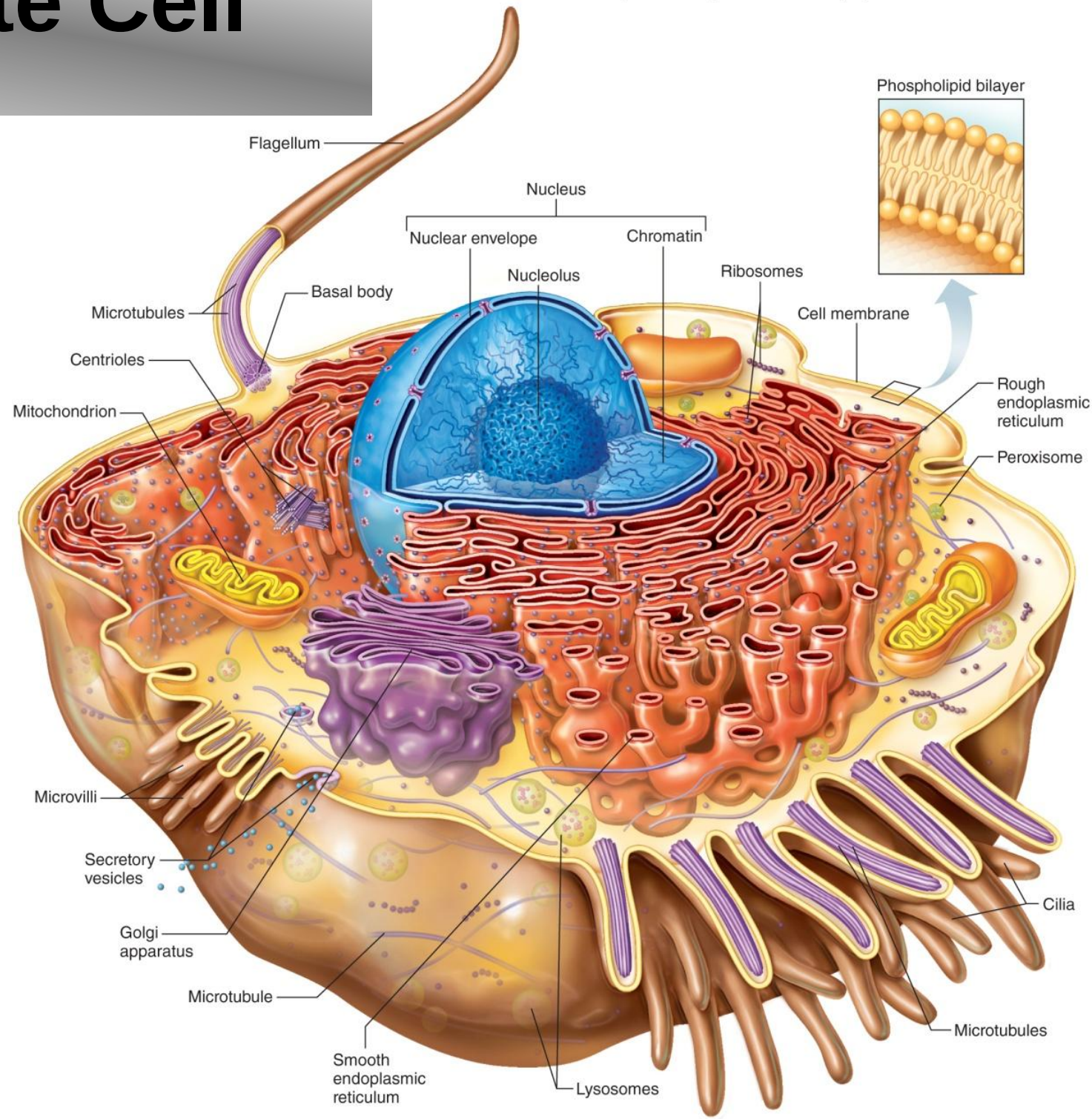
# Other Organelles

- Centrosome – forms a spindle during cell division
- Vesicles – packaged substances, exported
- Microfilaments and Microtubules - cell skeleton (cytoskeleton), maintains shape and functions in movement
- Vacuoles
- Microvilli
- Cilia & Flagella
- Ribosomes

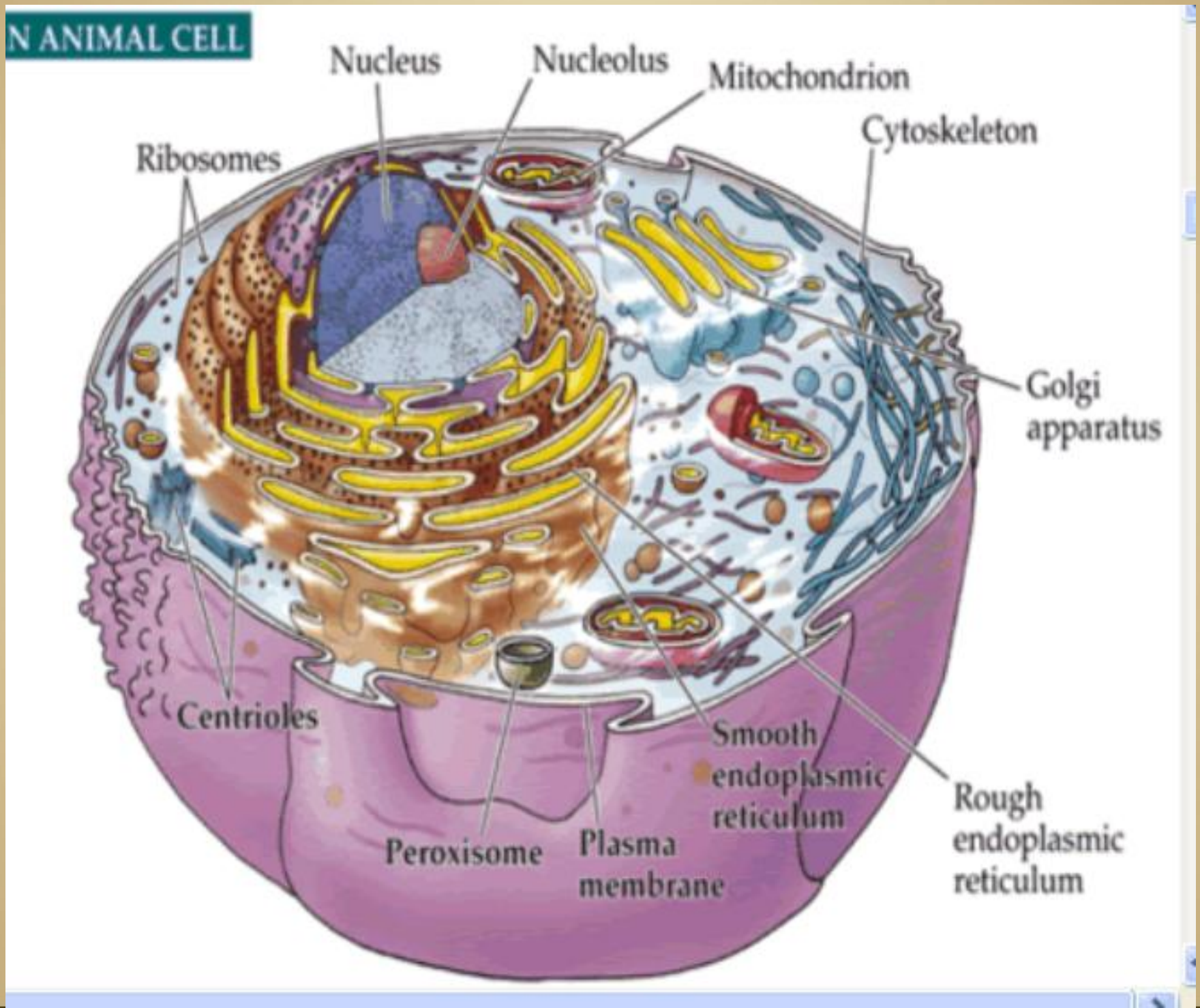


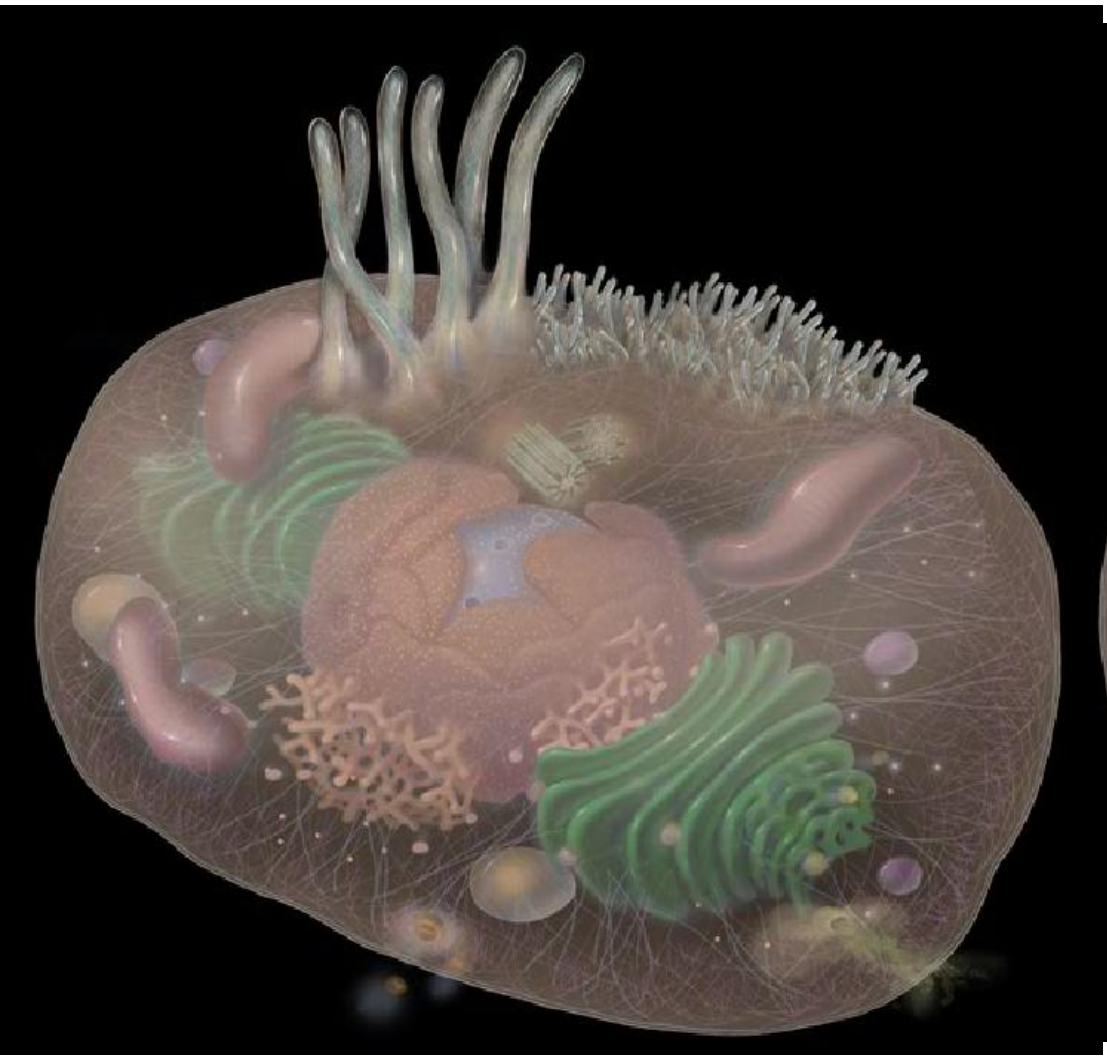
# A Composite Cell

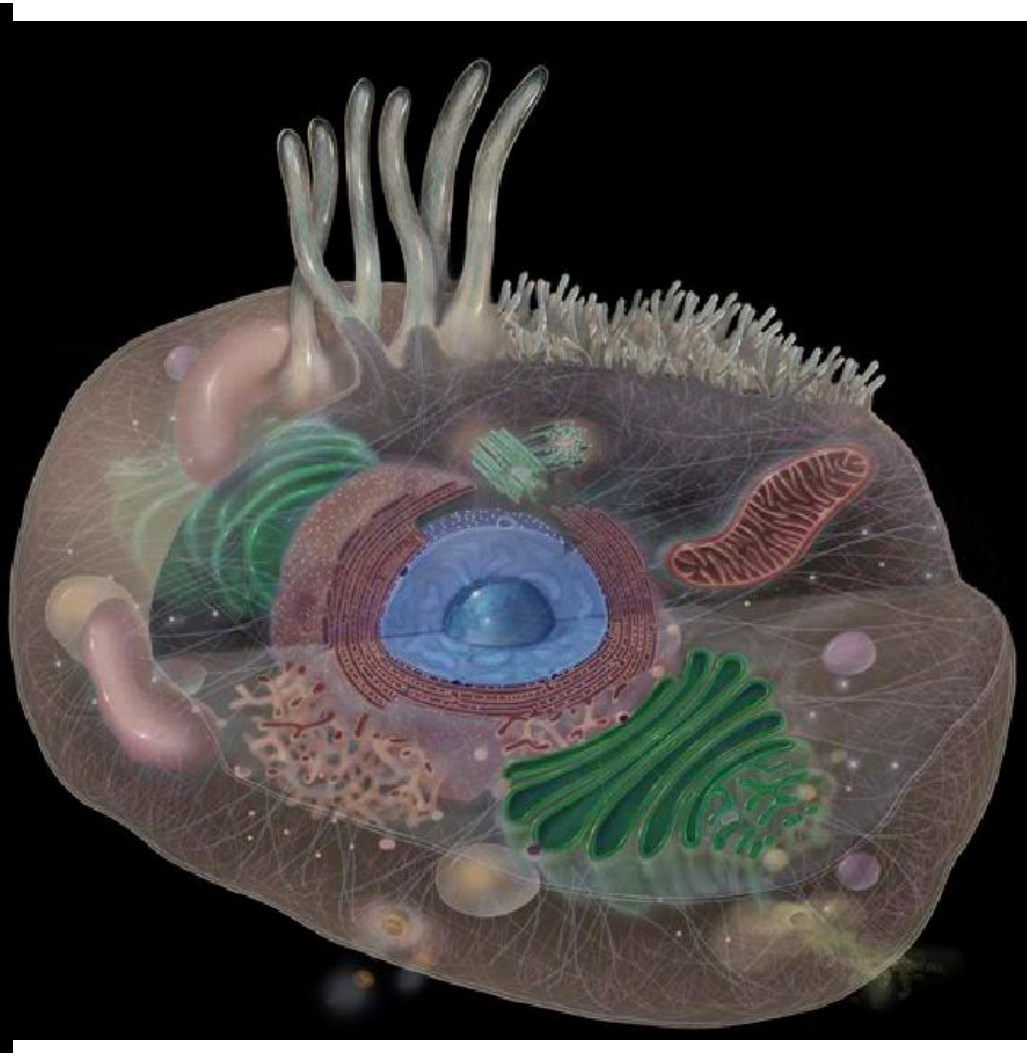




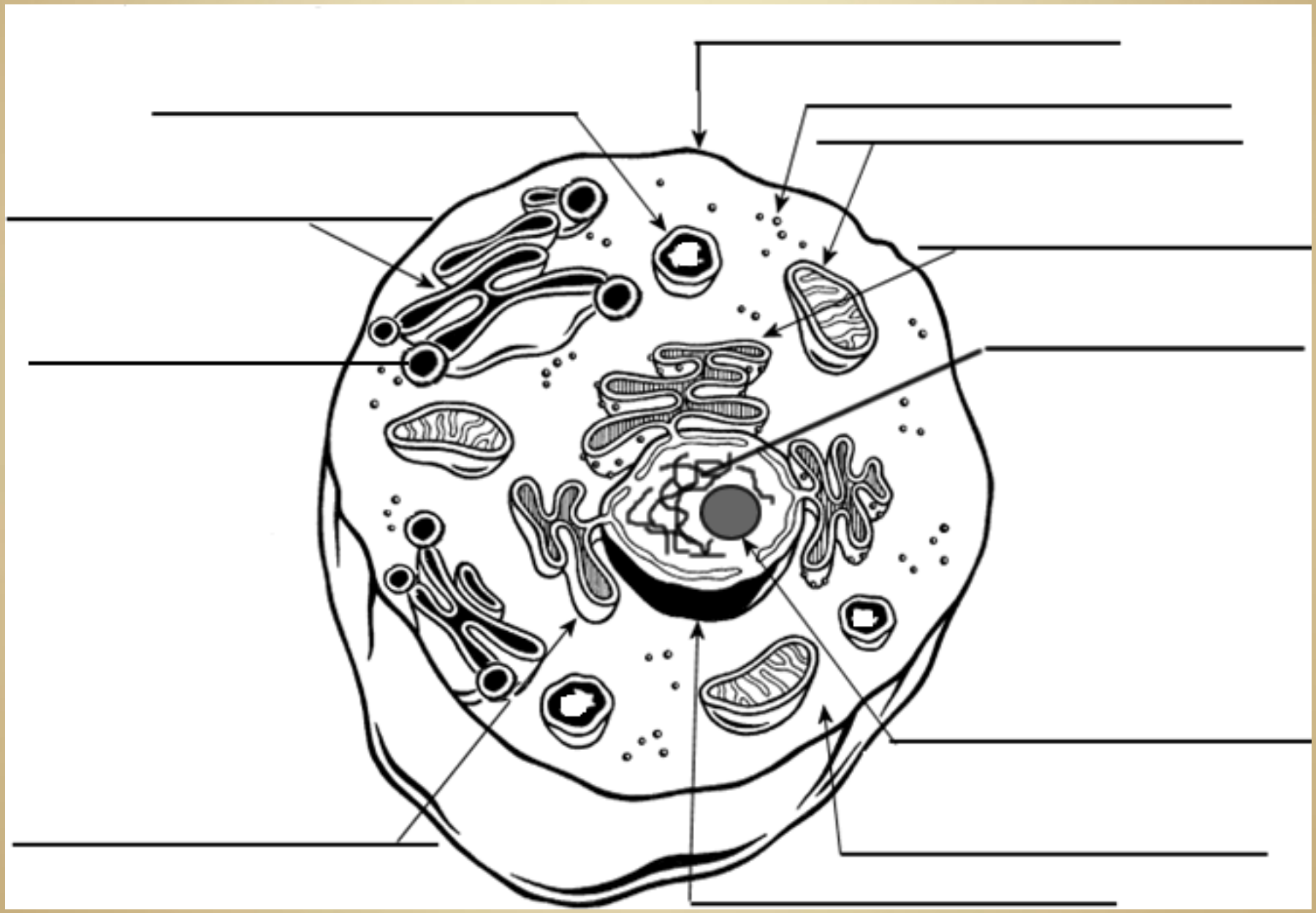
# The Whole Cell



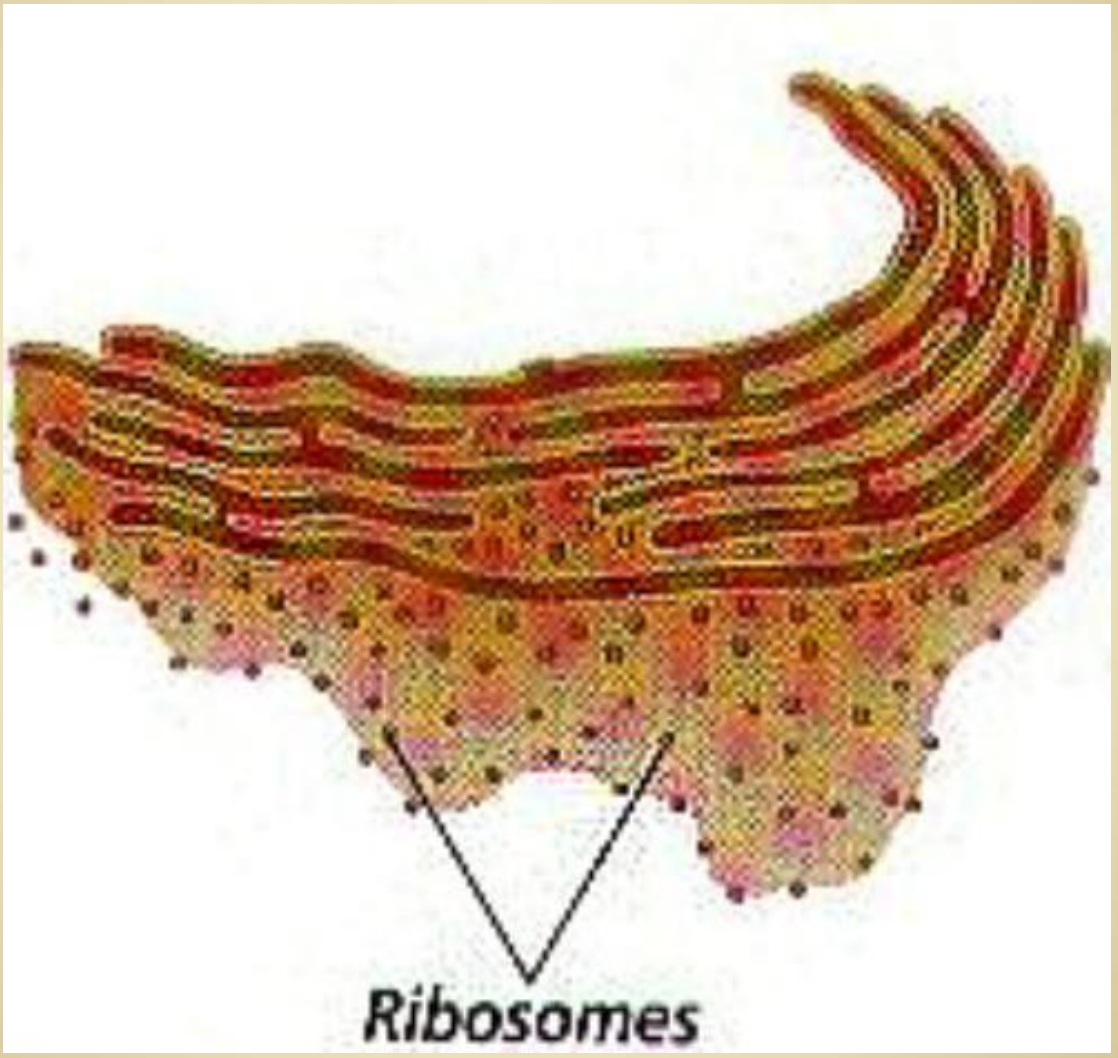




# Label This One



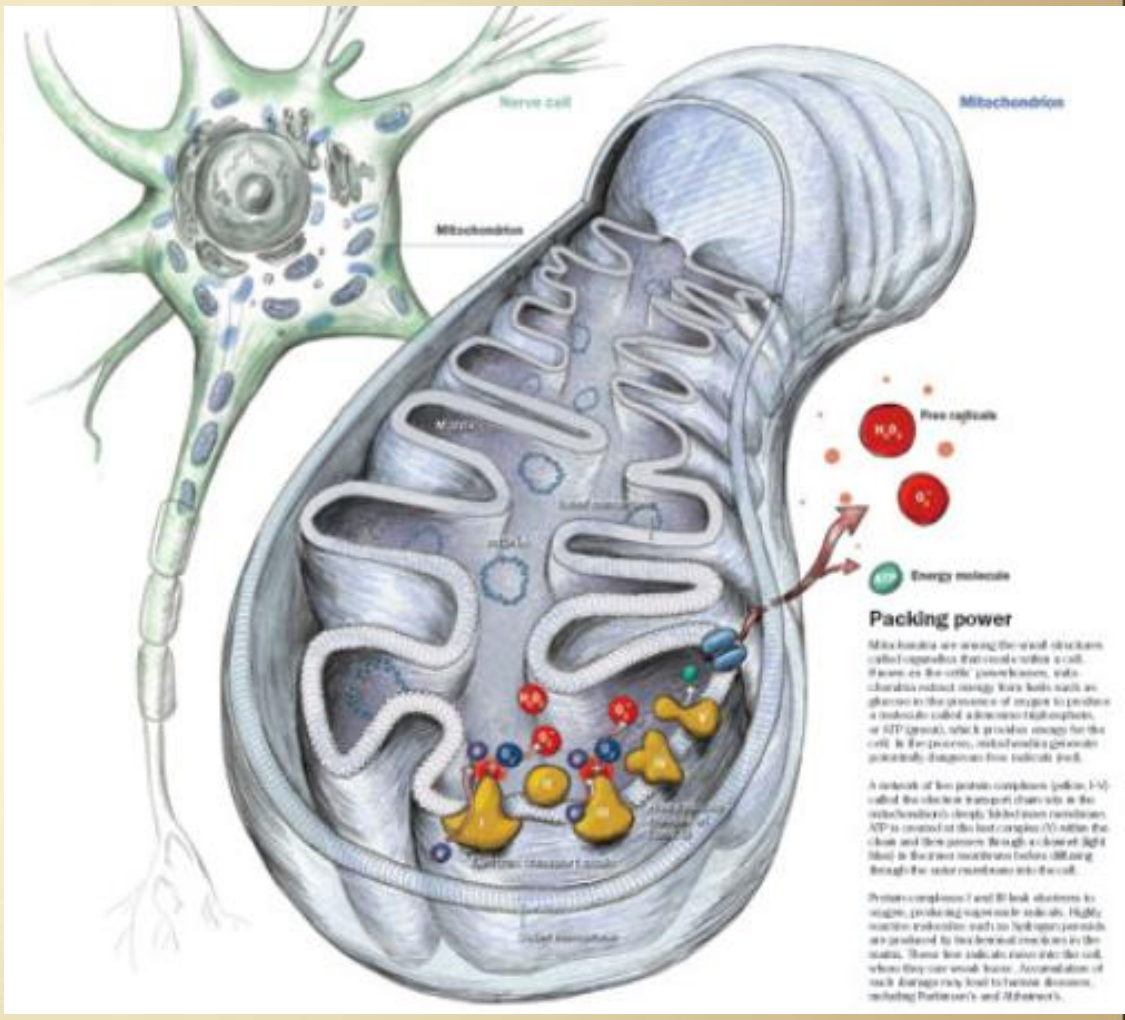
Quick: Name the structure



One more!:

Name the structure

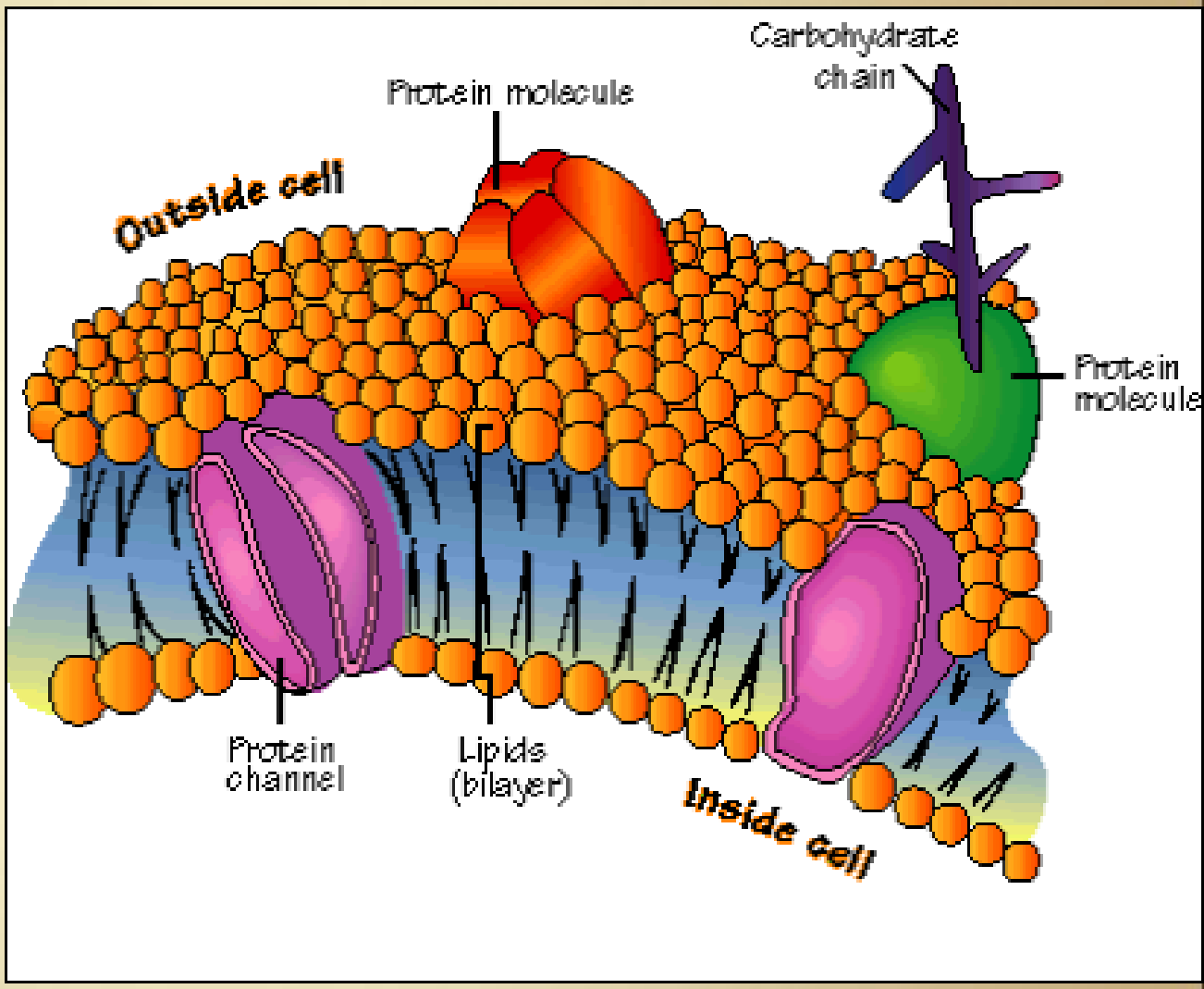
What is its function?



# Cell Membrane

Lipid bilayer (phospholipids) make up the membrane with proteins embedded to help regulate what comes across the membrane.

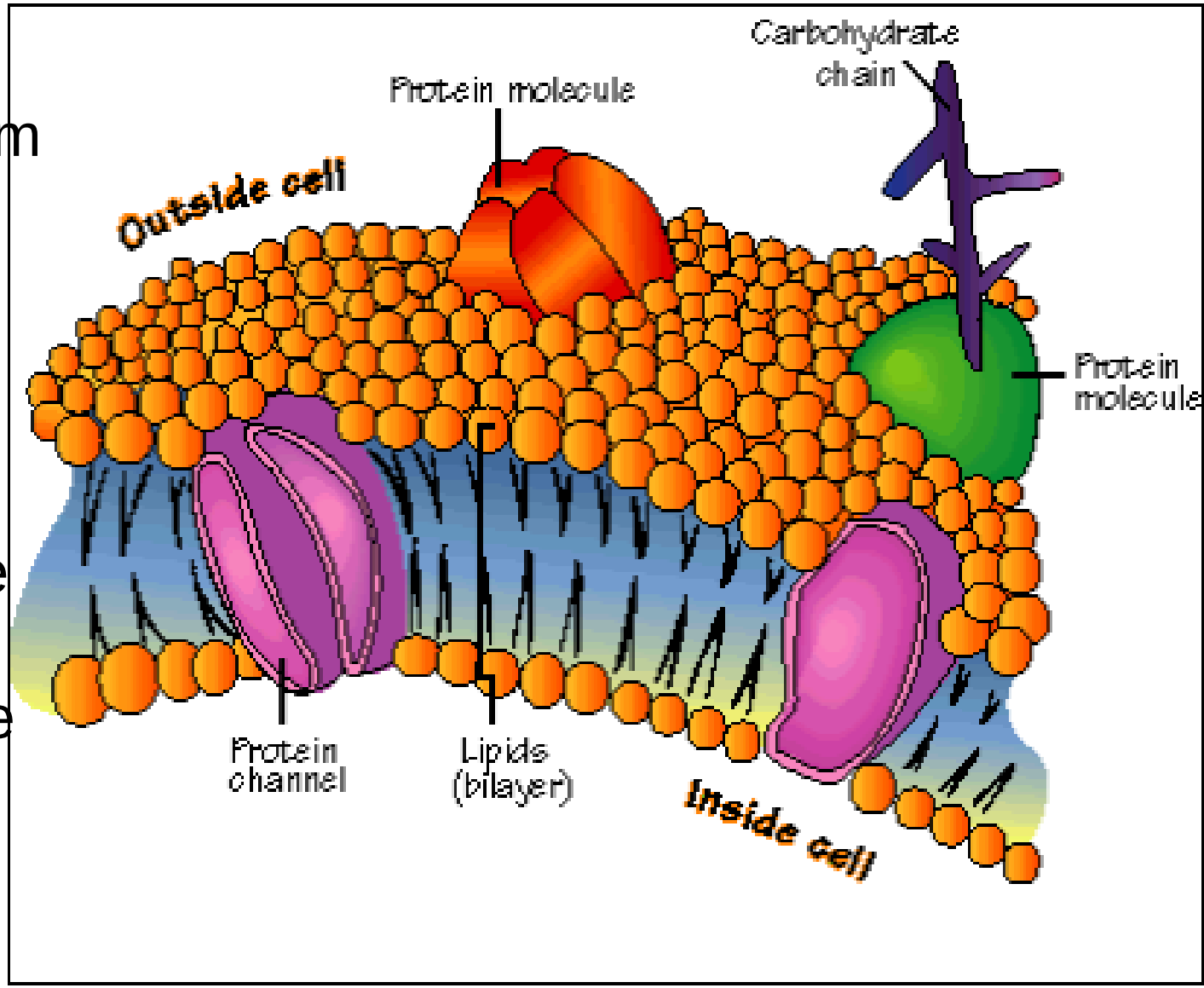
What sorts of things cross the cell membrane?



# Cell Membrane

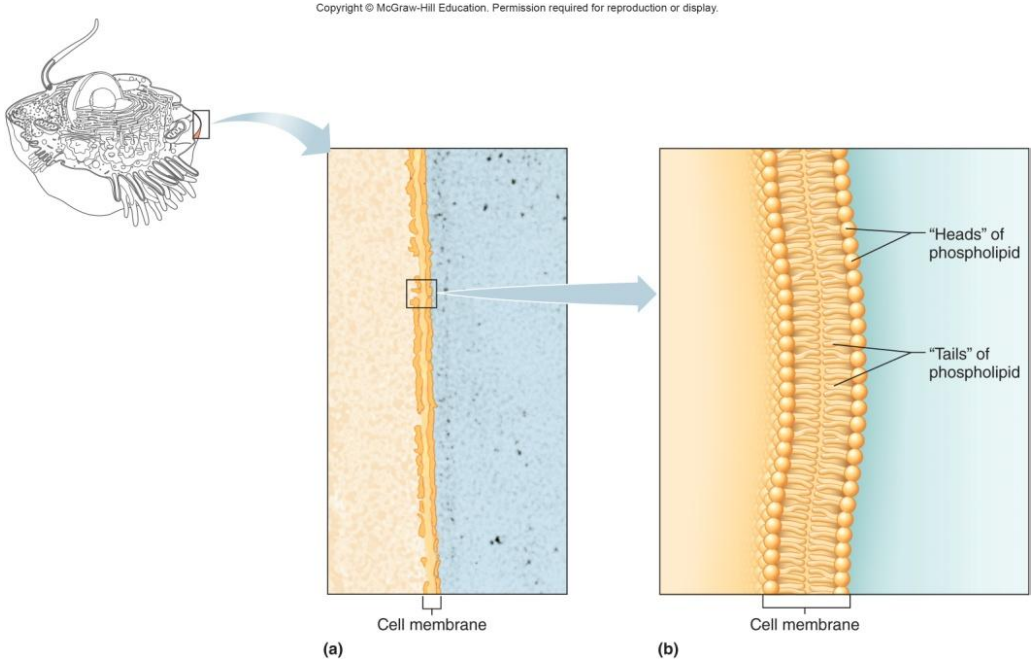
This lipid bilayer separates the **extracellular fluid** from the material inside the cell contained in the **cytoplasm.**

Proteins, cholesterol, and carbohydrates are also part of the membrane giving it the qualities of a **fluid mosaic.**

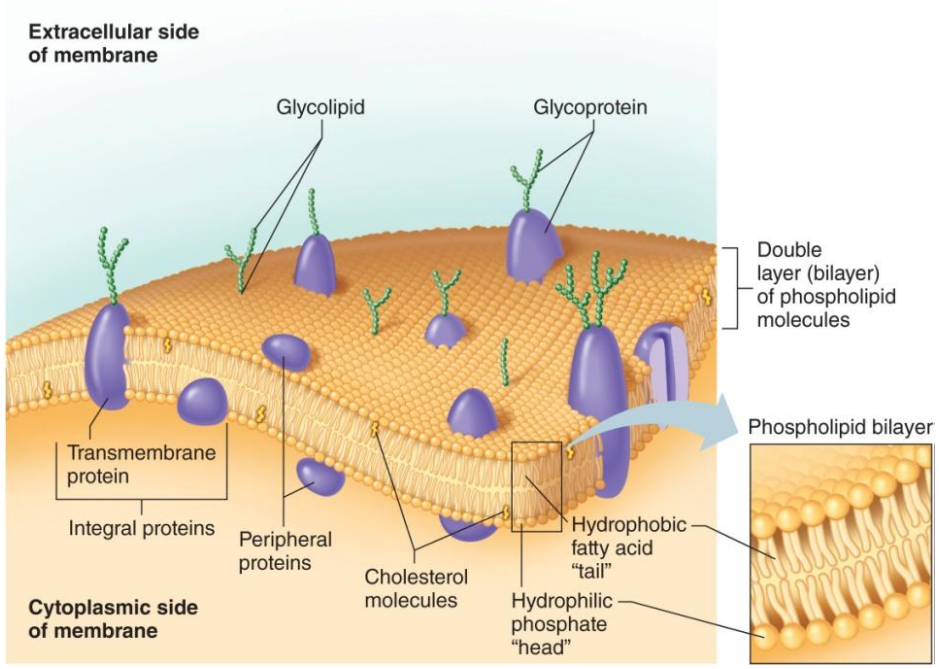


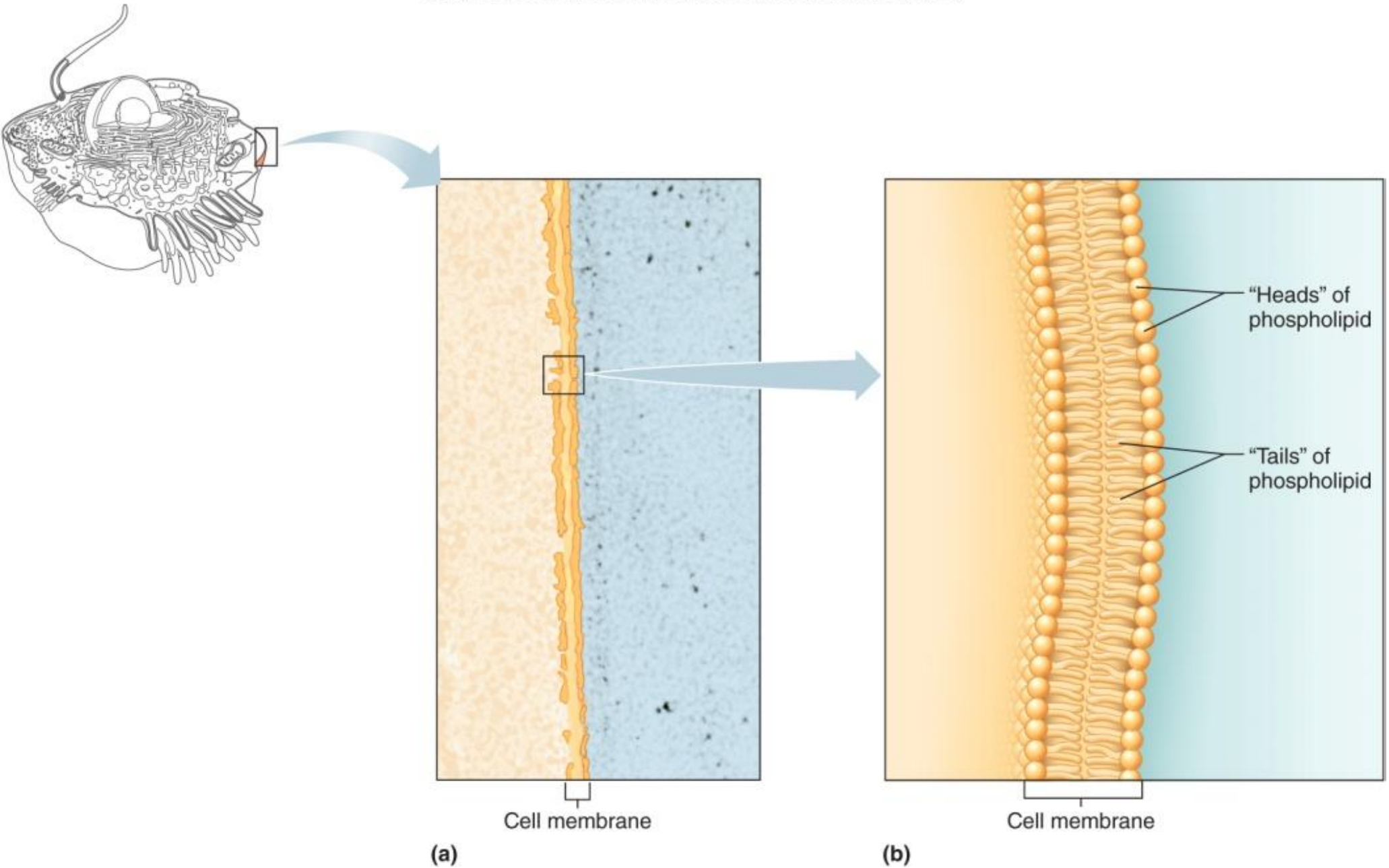
# Cell Membrane Structure

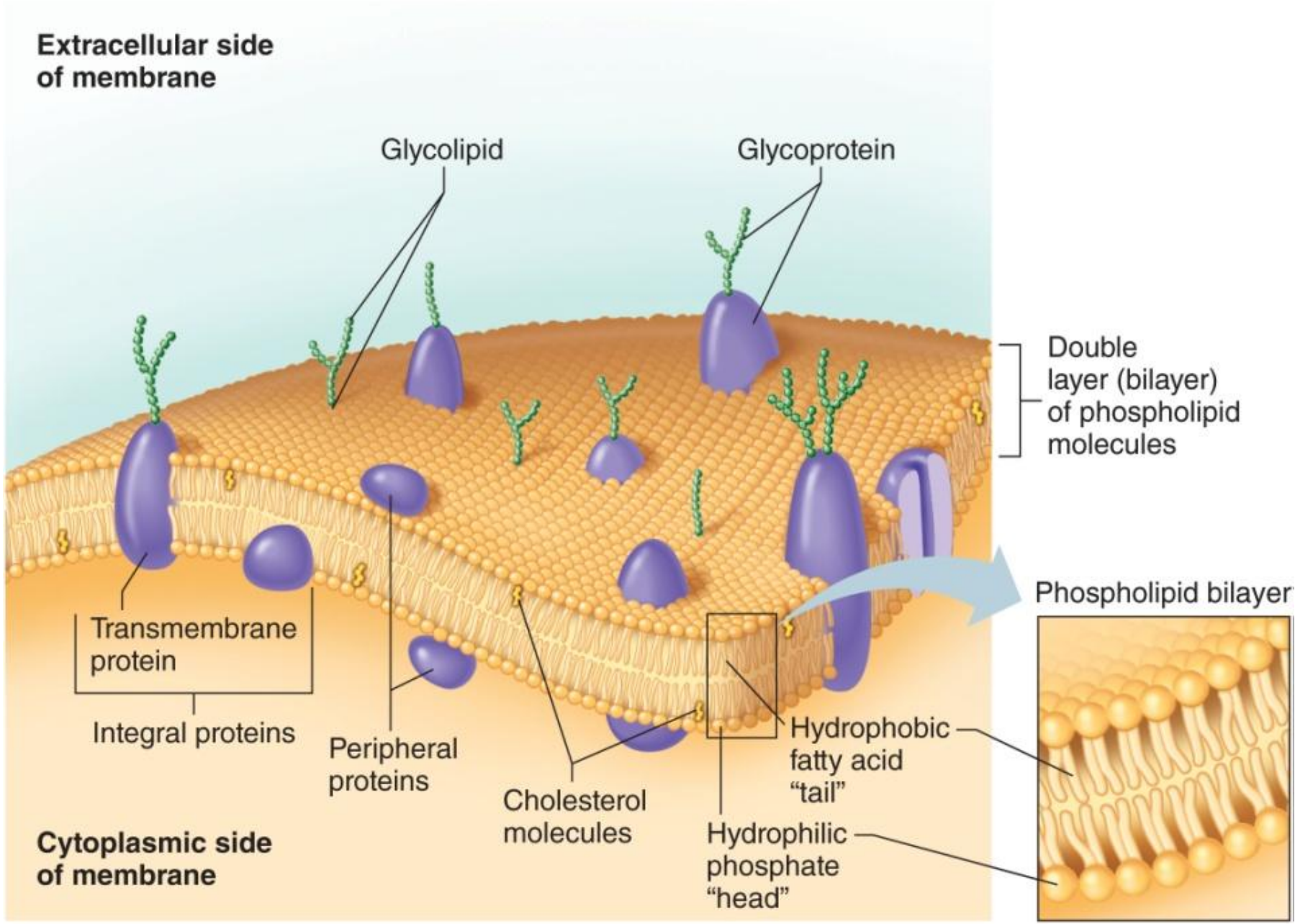










***Receptors*** facilitate communication between cells and ***cell adhesion molecules*** help cells to form tissues and organs.

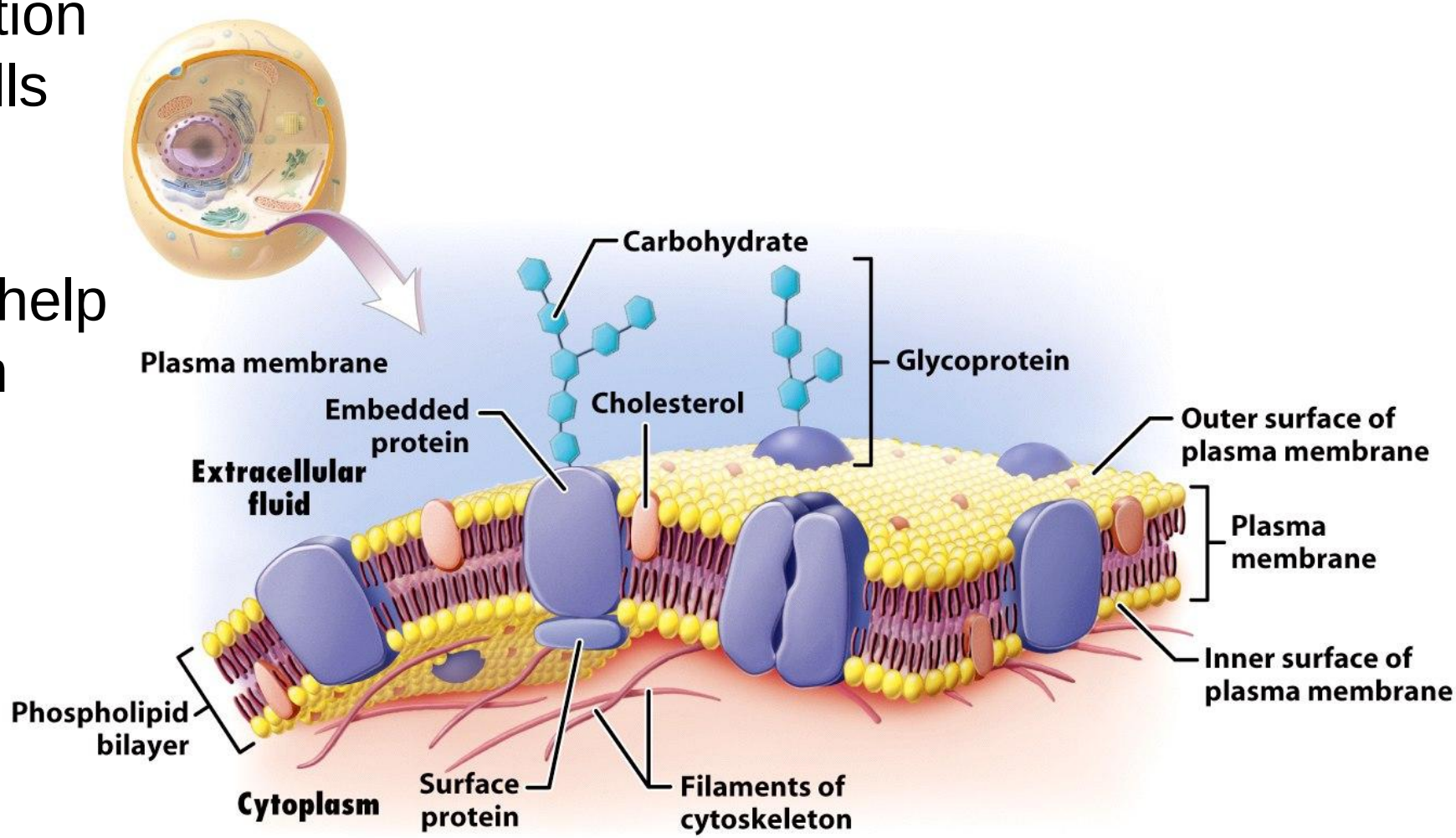
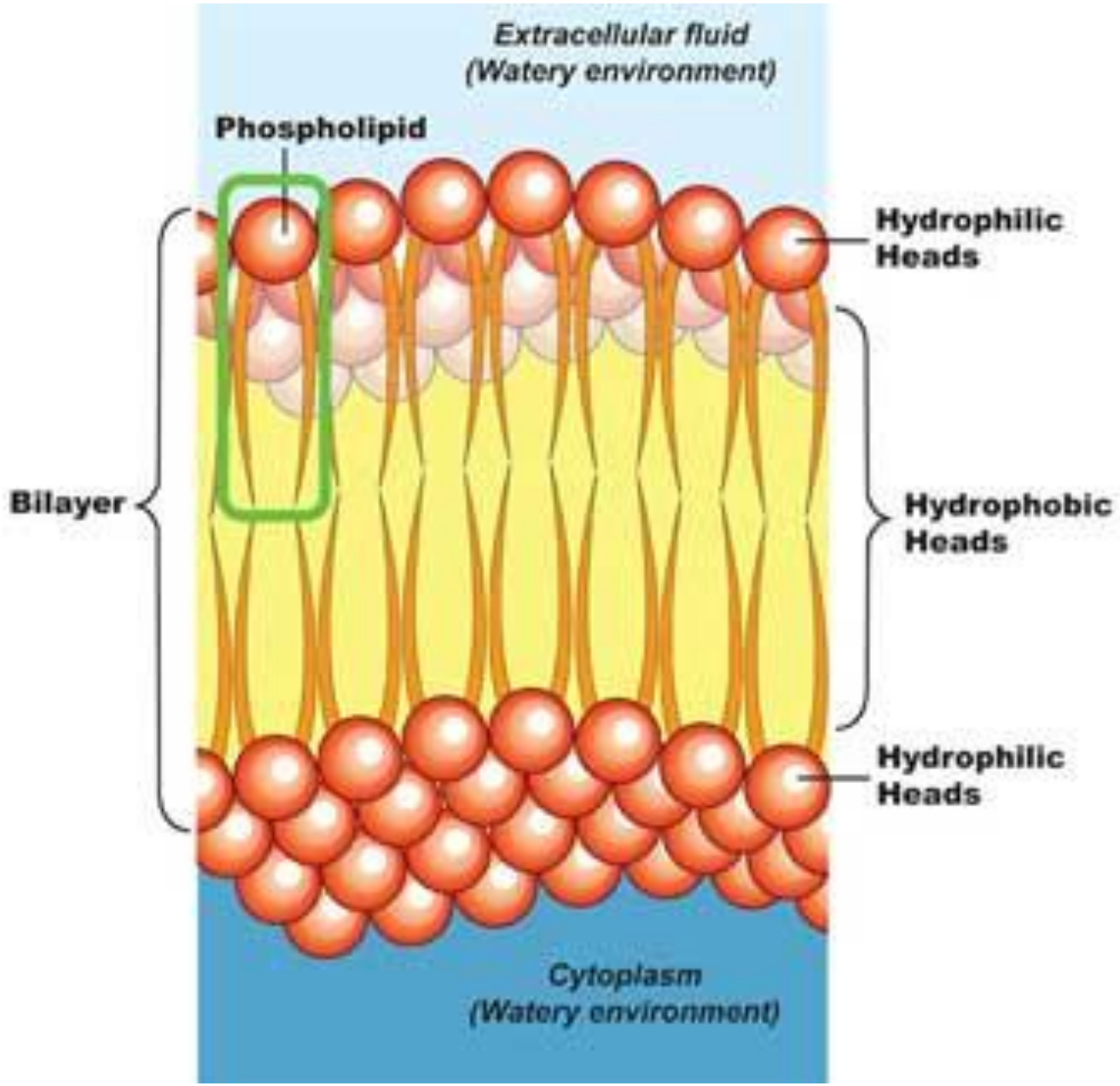



Figure 3-5 Biology of Humans, 2/e

# Hydrophobic and Hydrophilic



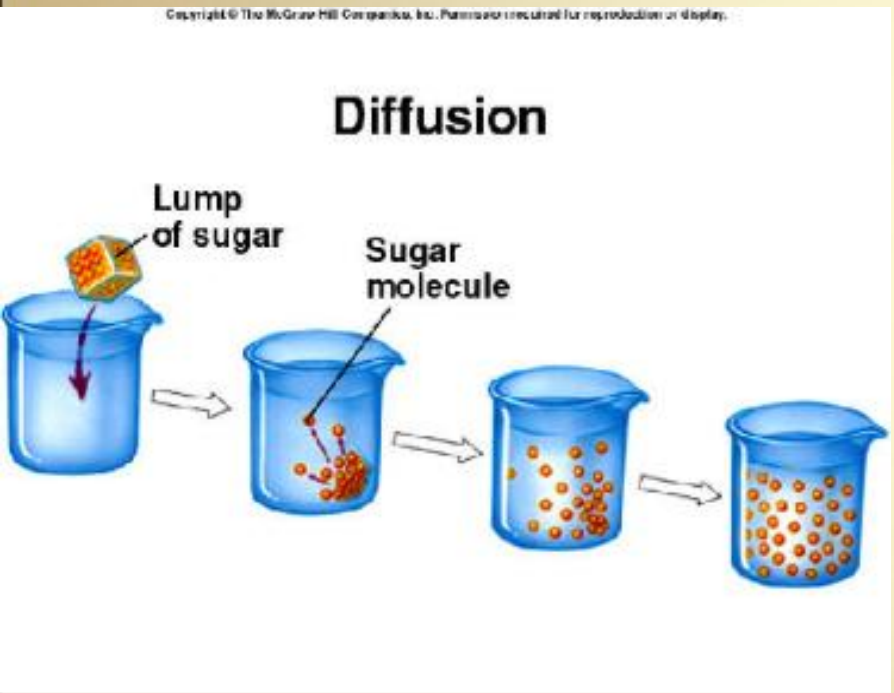
# B. Cell Transport-Movement across the cell membrane

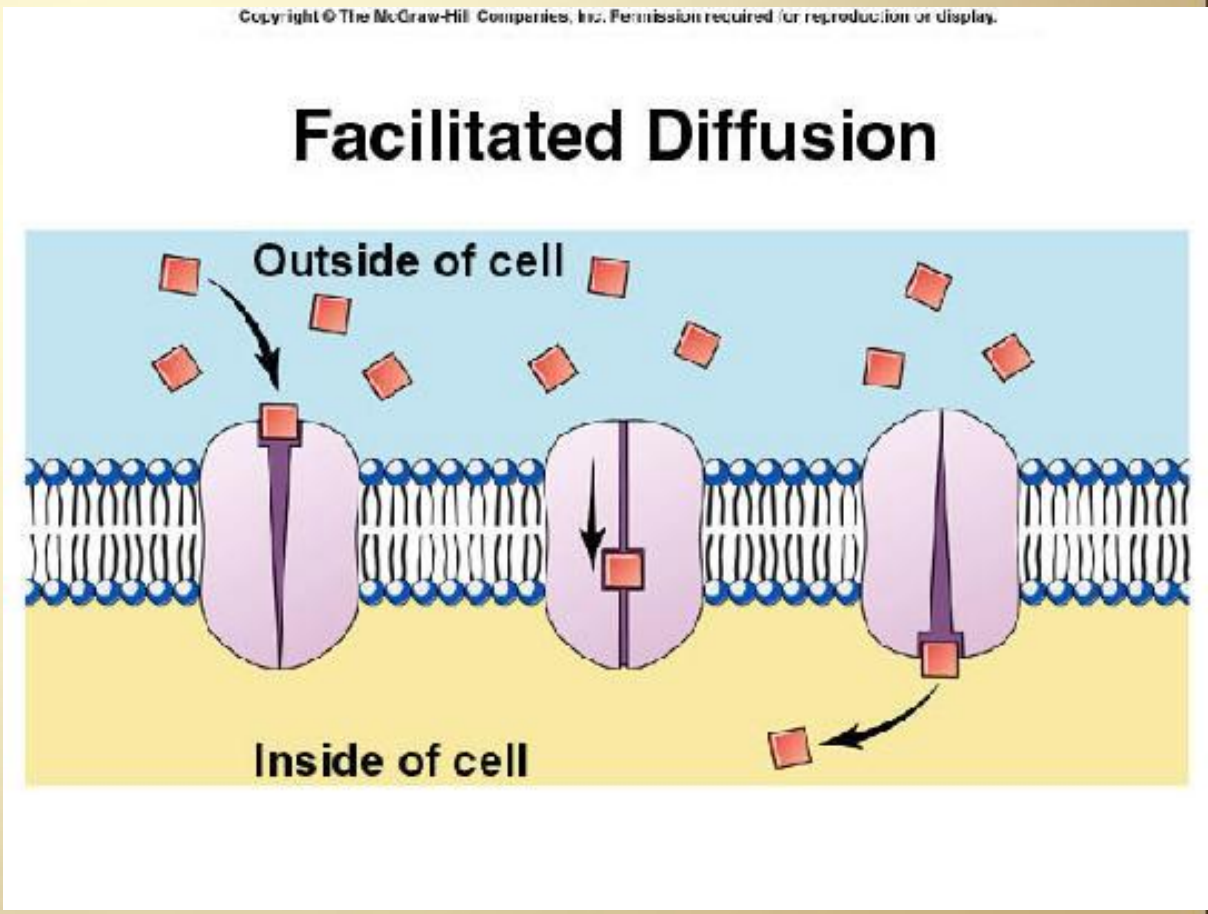
| Mechanism | Description |
| --- | --- |
| Simple diffusion | Random movement from region of higher to lower concentration |
| Facilitated diffusion | Movement from region of higher to lower concentration with the aid of a carrier or channel protein |
| Osmosis | Movement of water from region of higher water concentration (lower solute concentration) to lower water concentration (higher solute concentration) |
| Active transport | Movement often from region of lower to higher concentration with the aid of a carrier protein and energy usually from ATP |
| Endocytosis | Materials are engulfed by plasma membrane and drawn into cell in a vesicle |
| Exocytosis | Membrane-bound vesicle from inside the cell fuses with the plasma membrane and spills contents outside of cell |

# Movement Through Cell Membrane

Passive Transport *(no energy required*)

- Simple Diffusion - molecules tend to spread out
- Facilitated Diffusion




Diffusion Animation

# Passive Transport

**-Diffusion**
**-Facilitated Diffusion**
**-Osmosis**

Substances move from High to low concentration

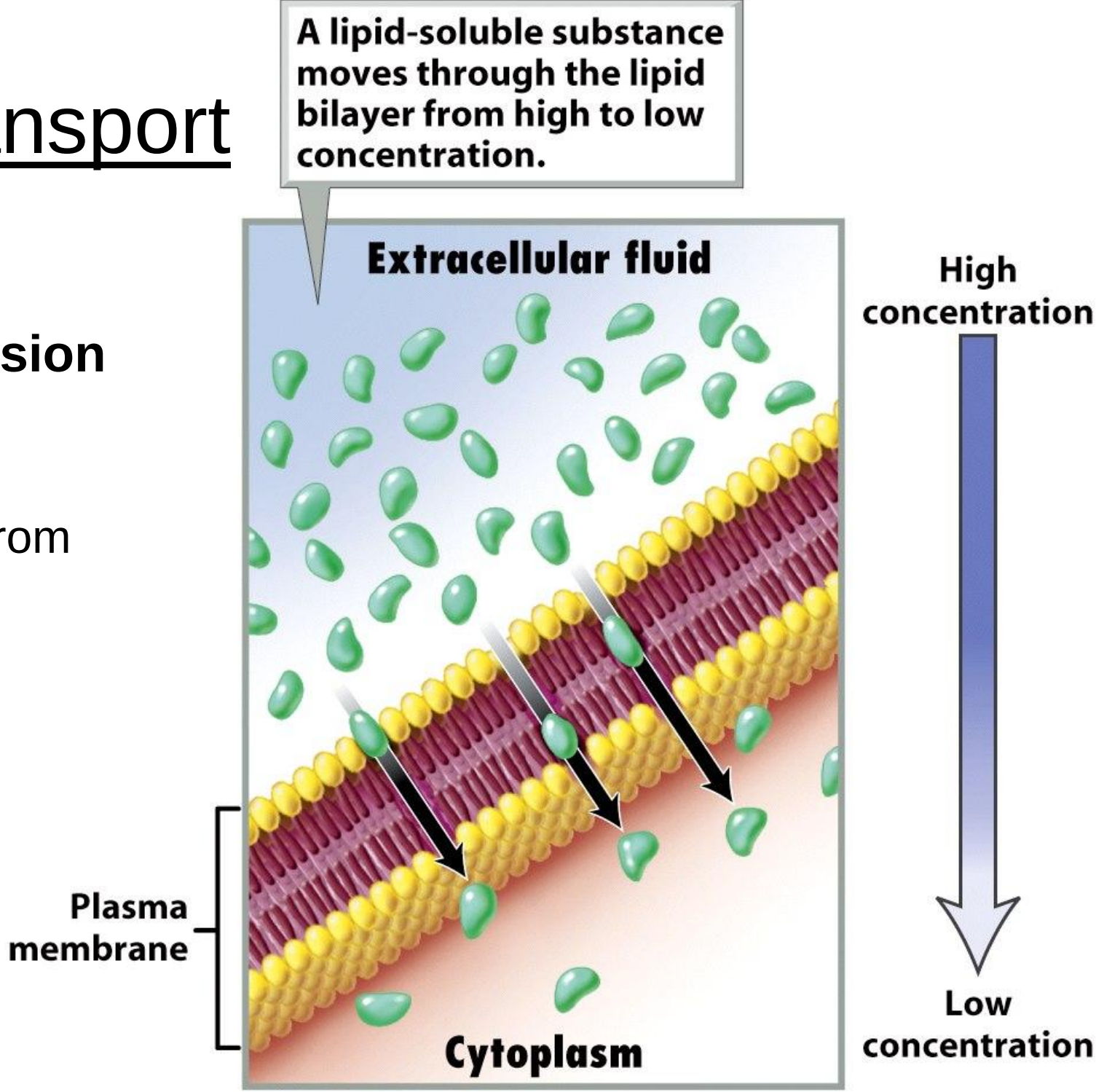


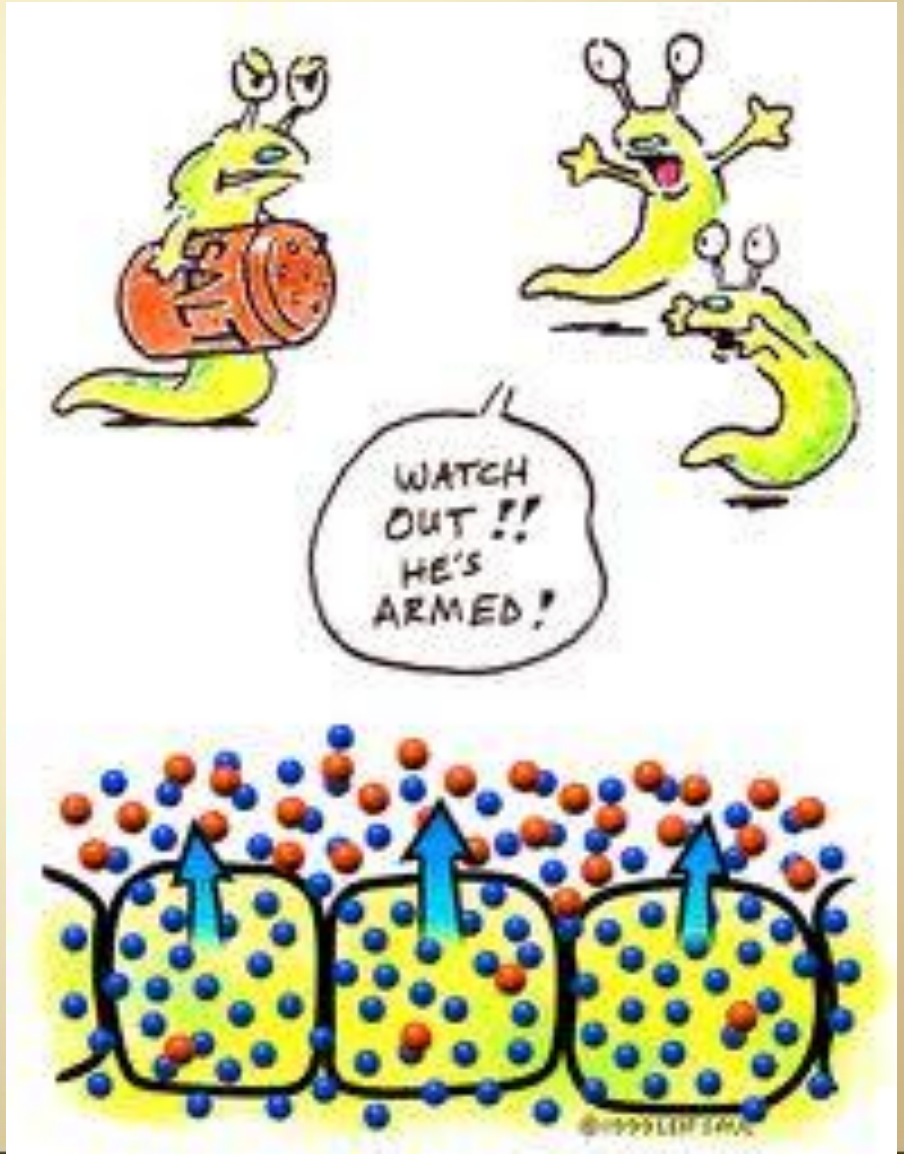

Figure 3-7 Biology of Humans, 2/e

# OSMOSIS

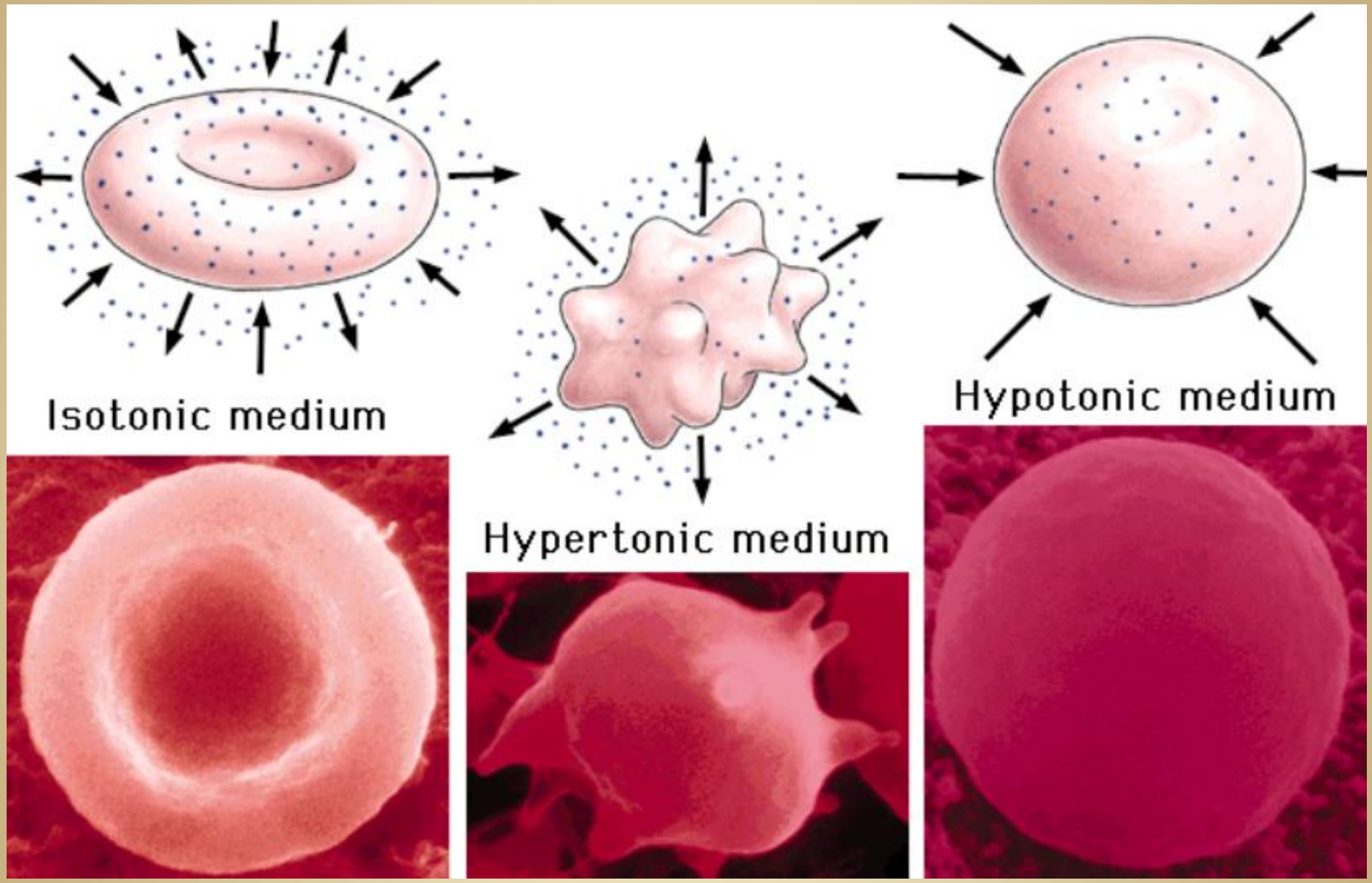
**Osmosis** is the movement of water across a membrane

-Net movement in the direction of higher solute concentration

SALT SUCKS




- Hypertonic
- Hypotonic
- Isotonic


Isotonic medium
Hypertonic medium
Hypotonic medium

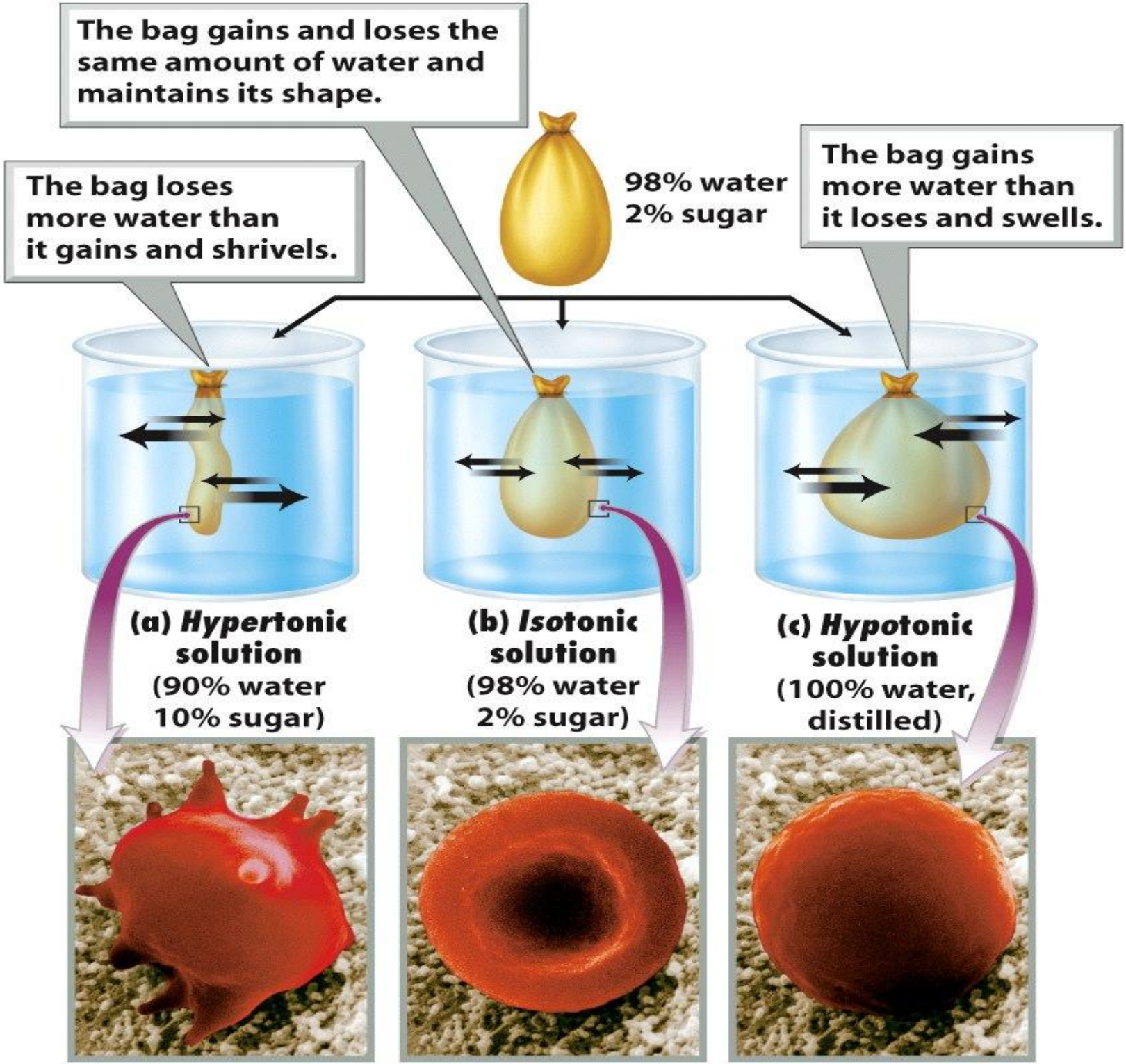
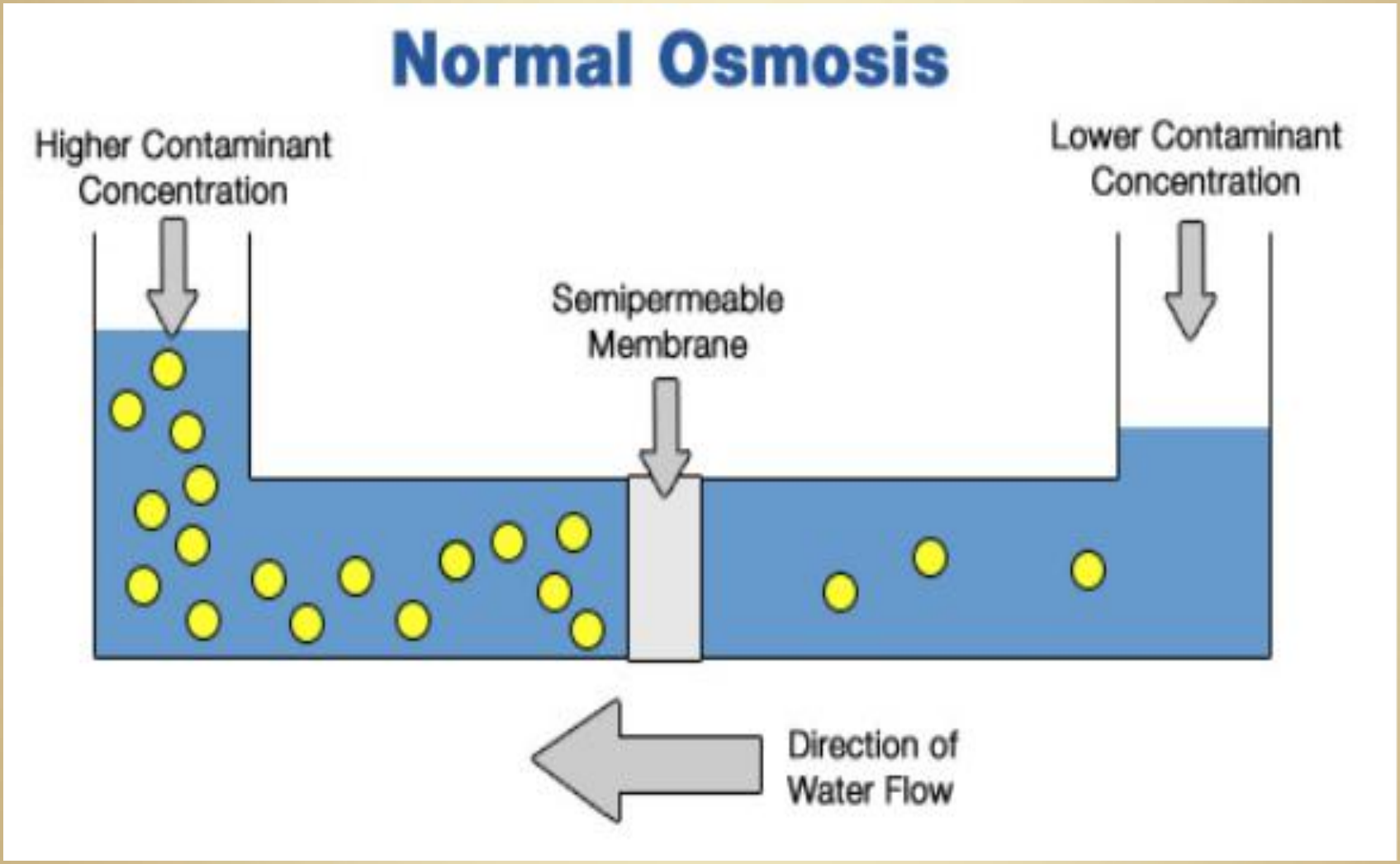


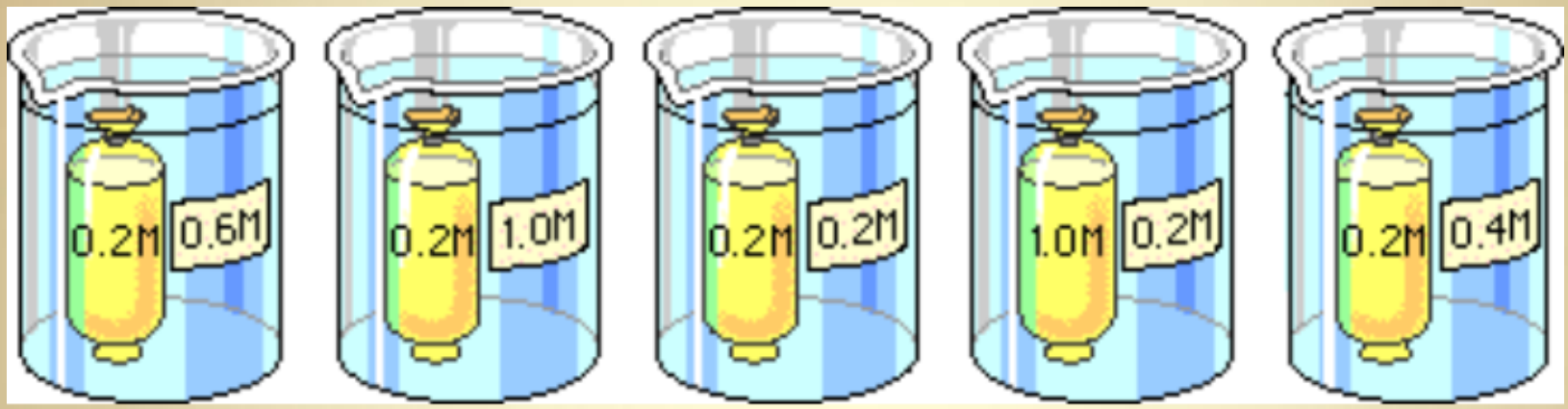

Figure 3-9 Biology of Humans, 2/e

# Osmosis Animation



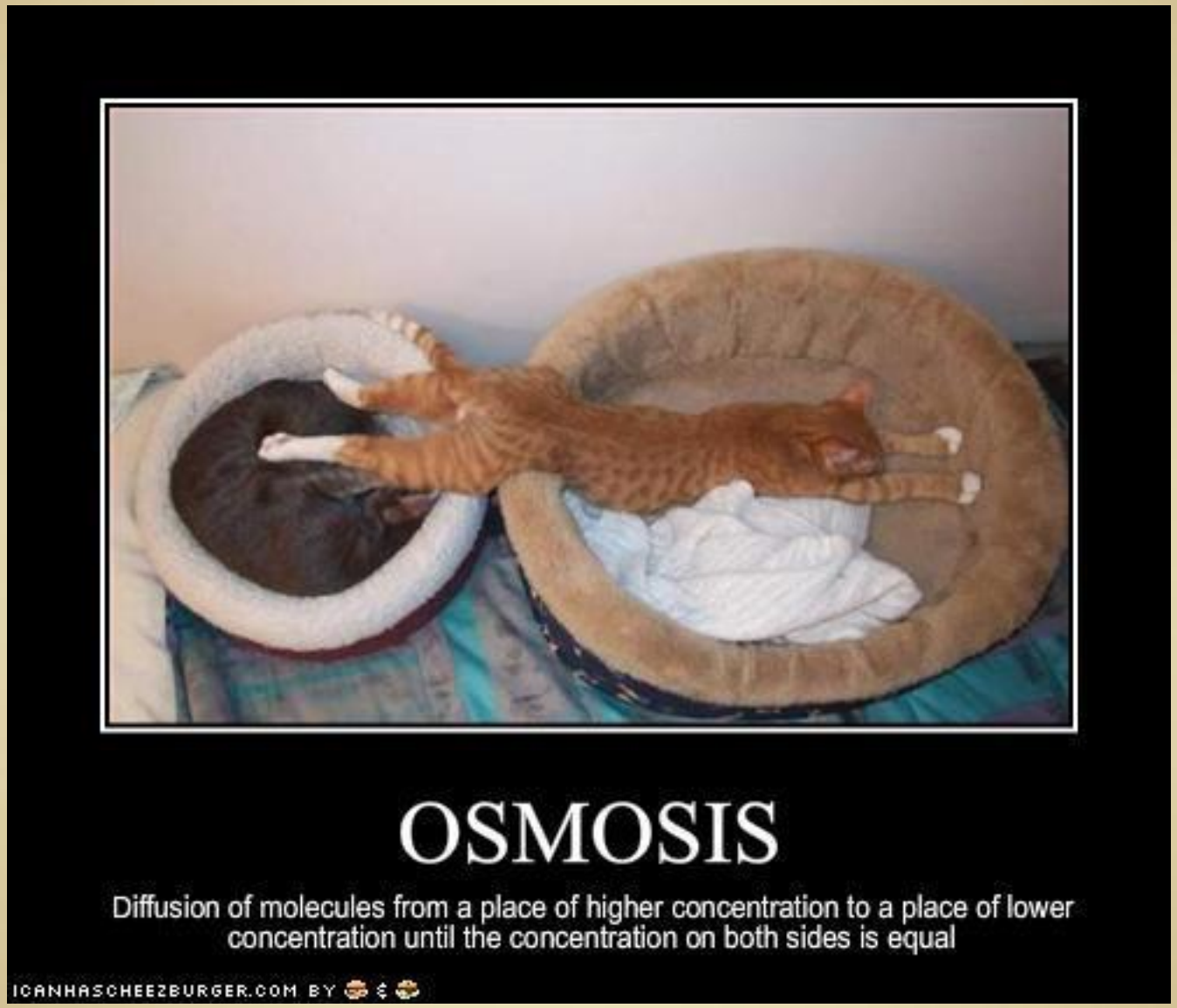
Example:

Which beaker(S) contains a solution that is hypertonic relative to the bag




A B C D E

What will happen to the baggie in the hypertonic solutions?


OSMOSIS
Diffusion of molecules from a place of higher concentration to a place of lower concentration until the concentration on both sides is equal
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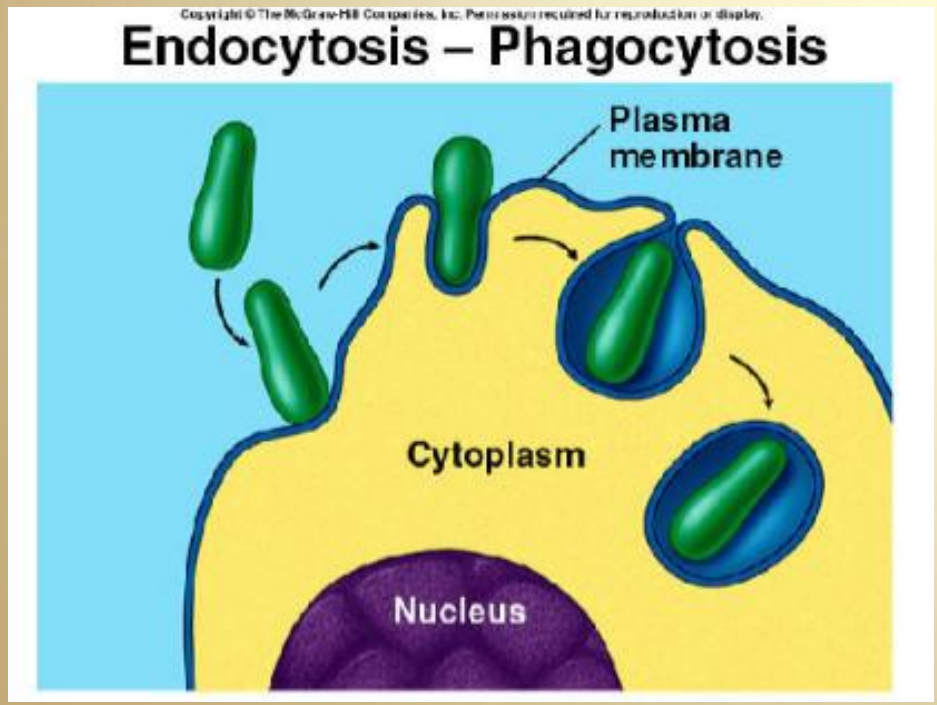
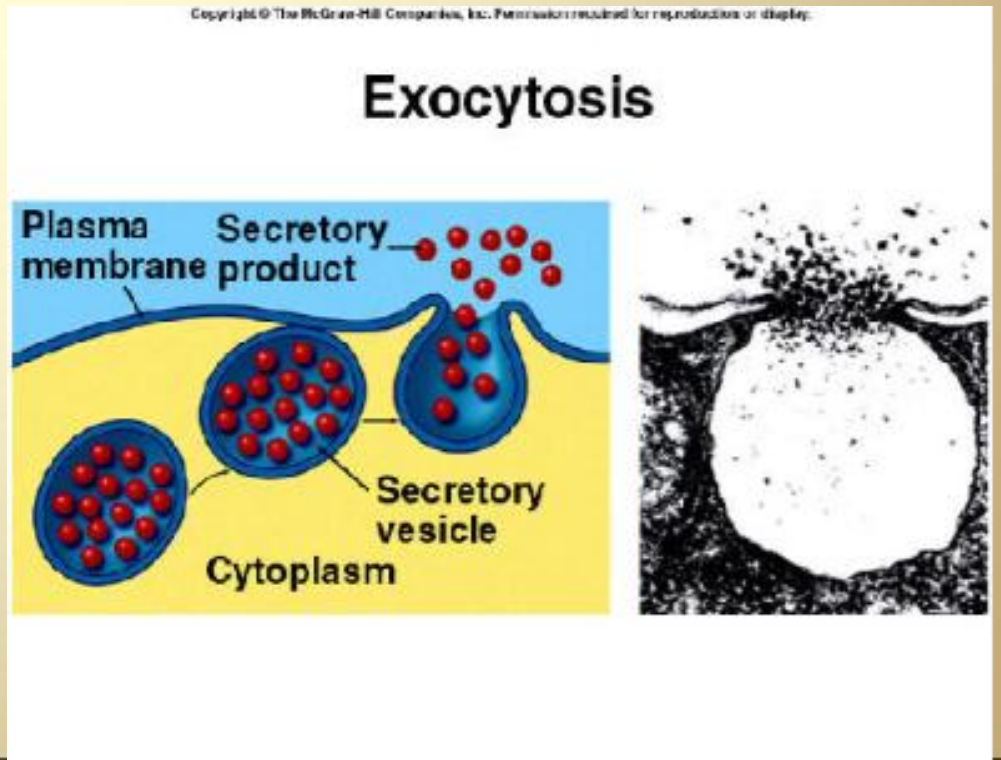
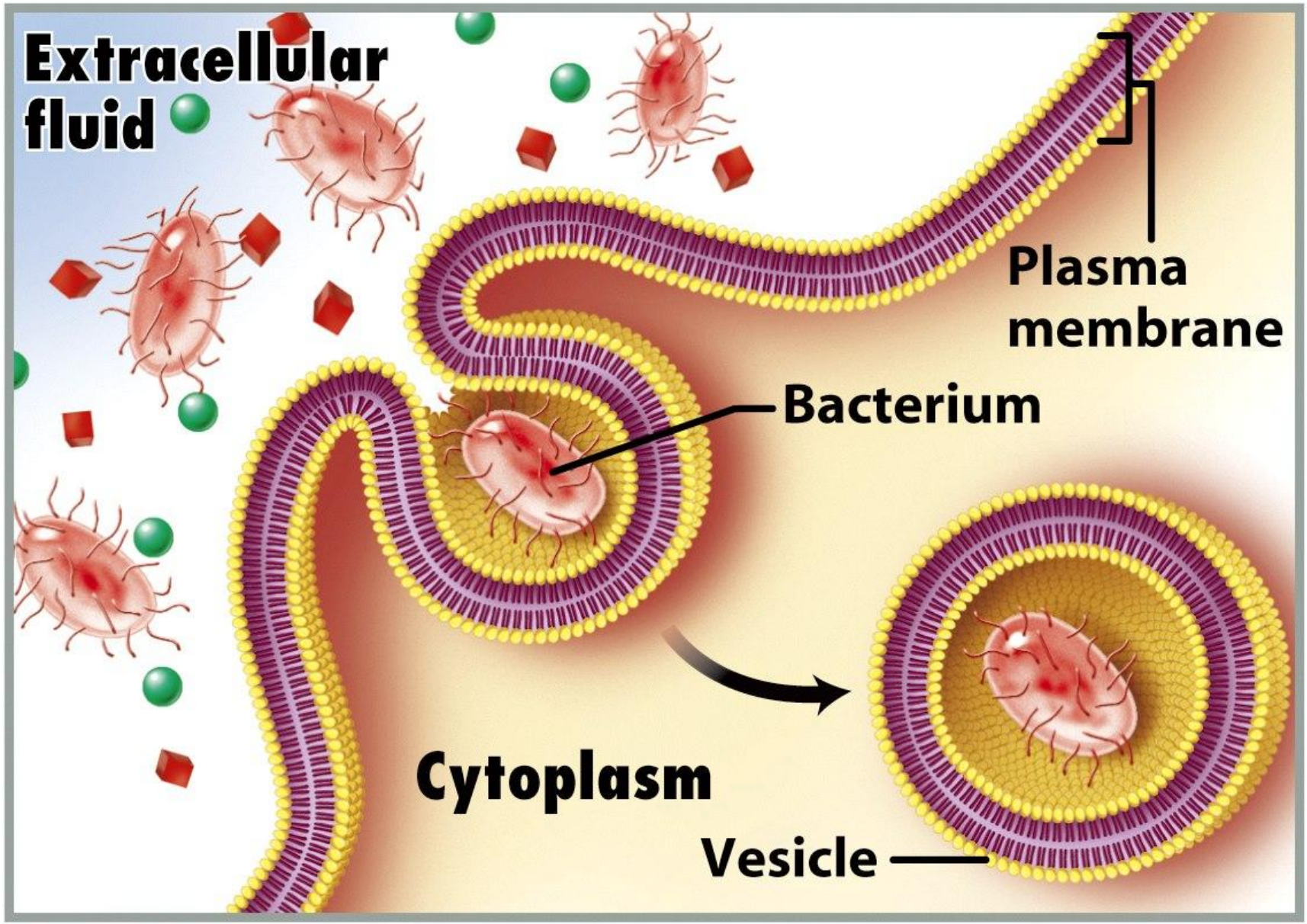
- Active Transport *(using energy)*
  - Exocytosis
  - Endocytosis (phagocytosis & pinocytosis)

To facilitate the movement of large particles into the cell, the membrane encloses the substance in a **vesicle**, a process called **endocytosis**

**Exocytosis** is the process whereby large molecules leave the cell






**Phagocytosis ("cell eating") occurs when cells engulf bacteria or other large particles.**

Figure 3-11a Biology of Humans, 2/e

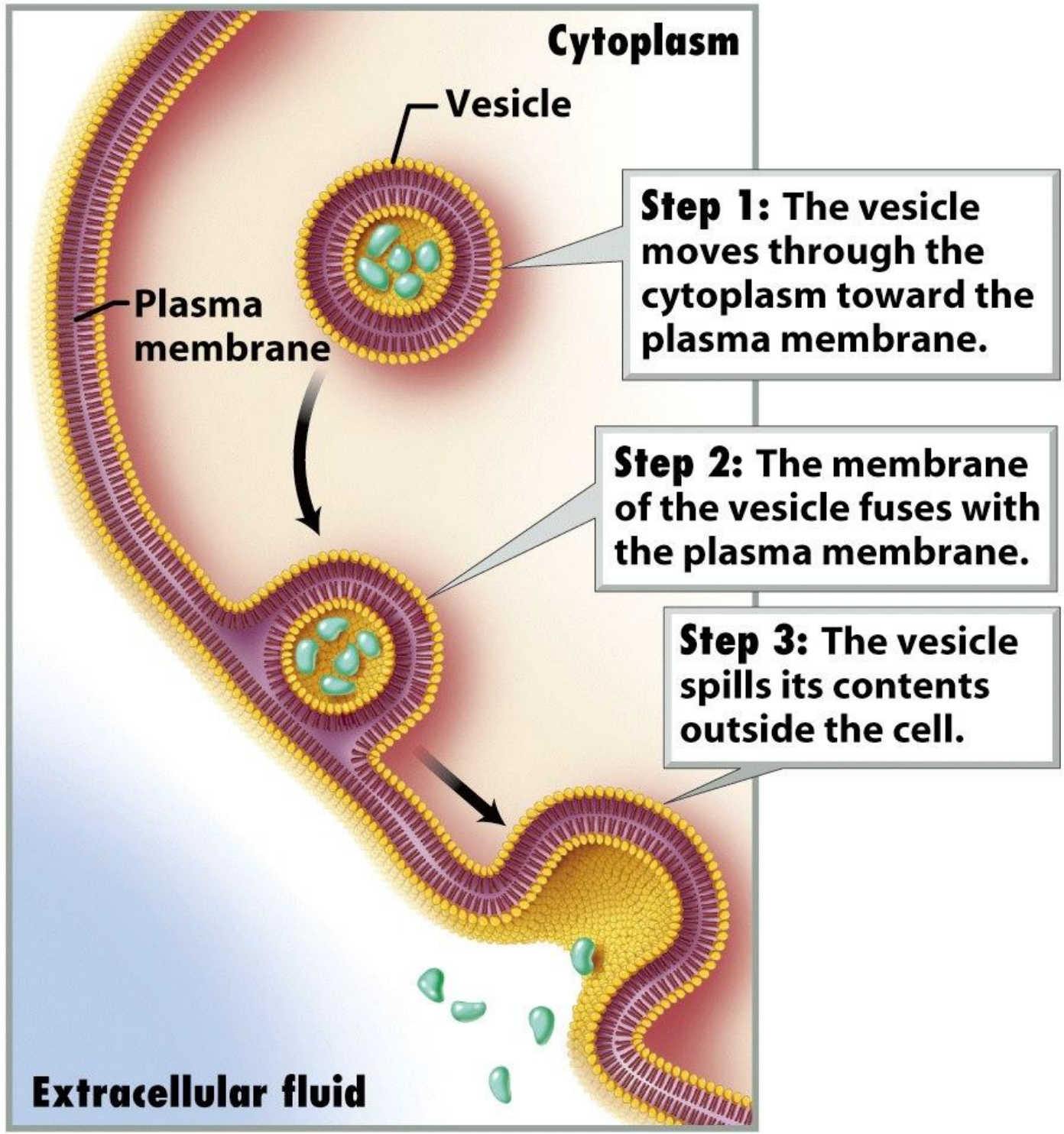
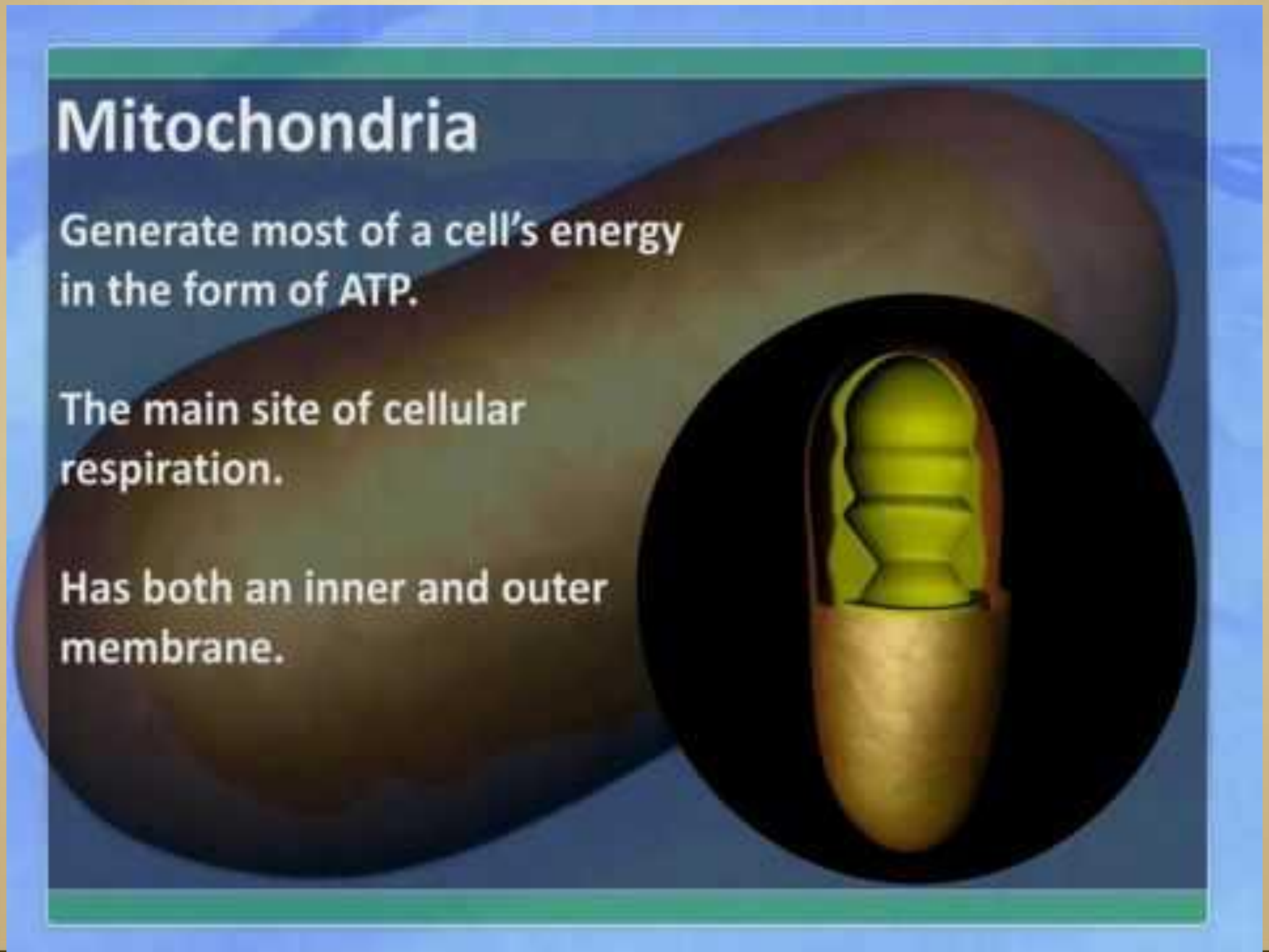



Figure 3-12 Biology of Humans, 2/e

# C. Cellular Respiration

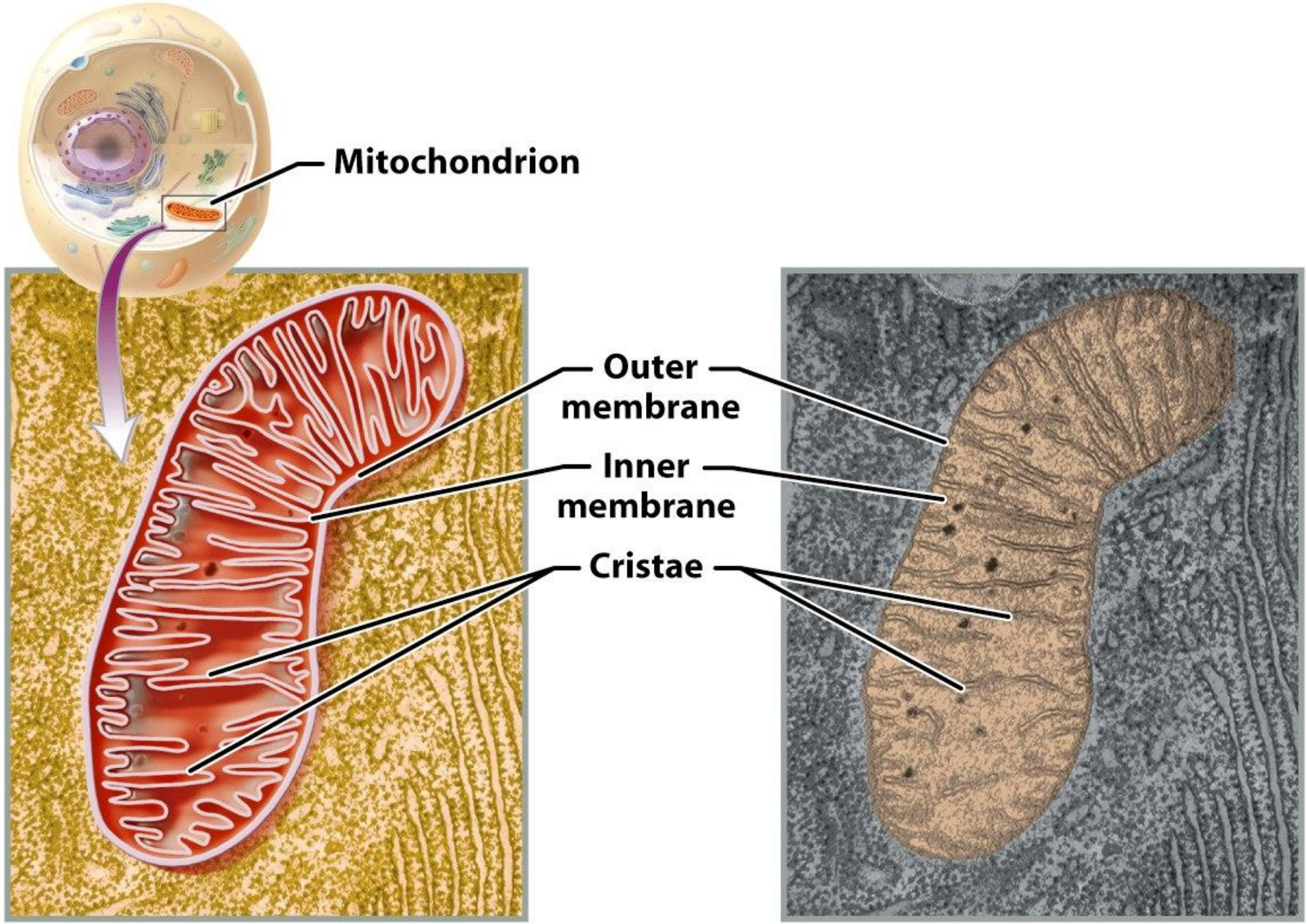


## TABLE 3.5 REVIEW OF CELLULAR RESPIRATION

| PHASE | LOCATION | DESCRIPTION | MAIN PRODUCTS |
|---|---|---|---|
| Glycolysis | Cytoplasm | Several-step process by which glucose is split into 2 pyruvate | 2 pyruvate<br>2 ATP<br>2 NADH |
| Transition reaction | Mitochondria | One $CO_2$ is removed from each pyruvate; the resulting molecules bind to CoA, forming 2 acetyl CoA | 2 acetyl CoA<br>2 NADH |
| Citric acid cycle | Mitochondria | Cyclic series of eight chemical reactions by which acetyl CoA is broken down | 2 ATP<br>2 $FADH_2$<br>6 NADH |
| Electron transport chain | Mitochondria | Electrons from NADH and $FADH_2$ are passed from one protein to the next, releasing energy for ATP synthesis | 32 ATP<br>$H_2O$ |

Table 3-5 Biology of Humans, 2/e


[Cellular Respiration Video]




**(a) A mitochondrion showing the double membrane that creates two compartments**

**(b) Electron micrograph of a mitochondrion**

Figure 3-19 Biology of Humans, 2/e

# Cellular Respiration

Cellular Respiration requires oxygen to breakdown glucose in a three step process.

1. **Glycolysis** occurs in the cytoplasm splitting glucose into two pyruvate molecules generating a net gain of two ATP and two NADH molecules.

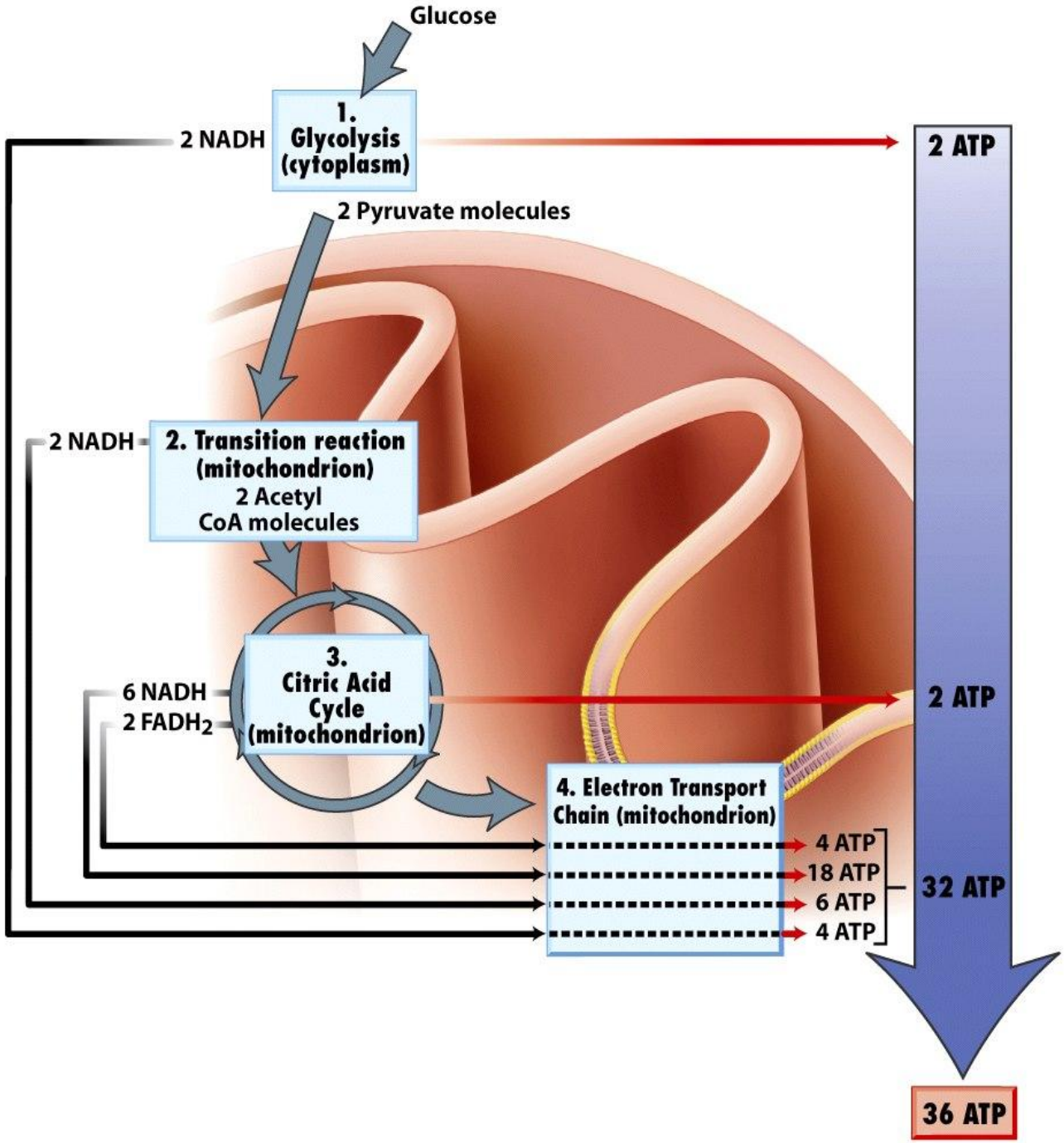



Figure 3-30 Biology of Humans, 2/e

2. Acetyl CoA enters the citric acid cycle (**Kreb's Cycle**) releasing two ATP, two FADH2, and six NADH molecules

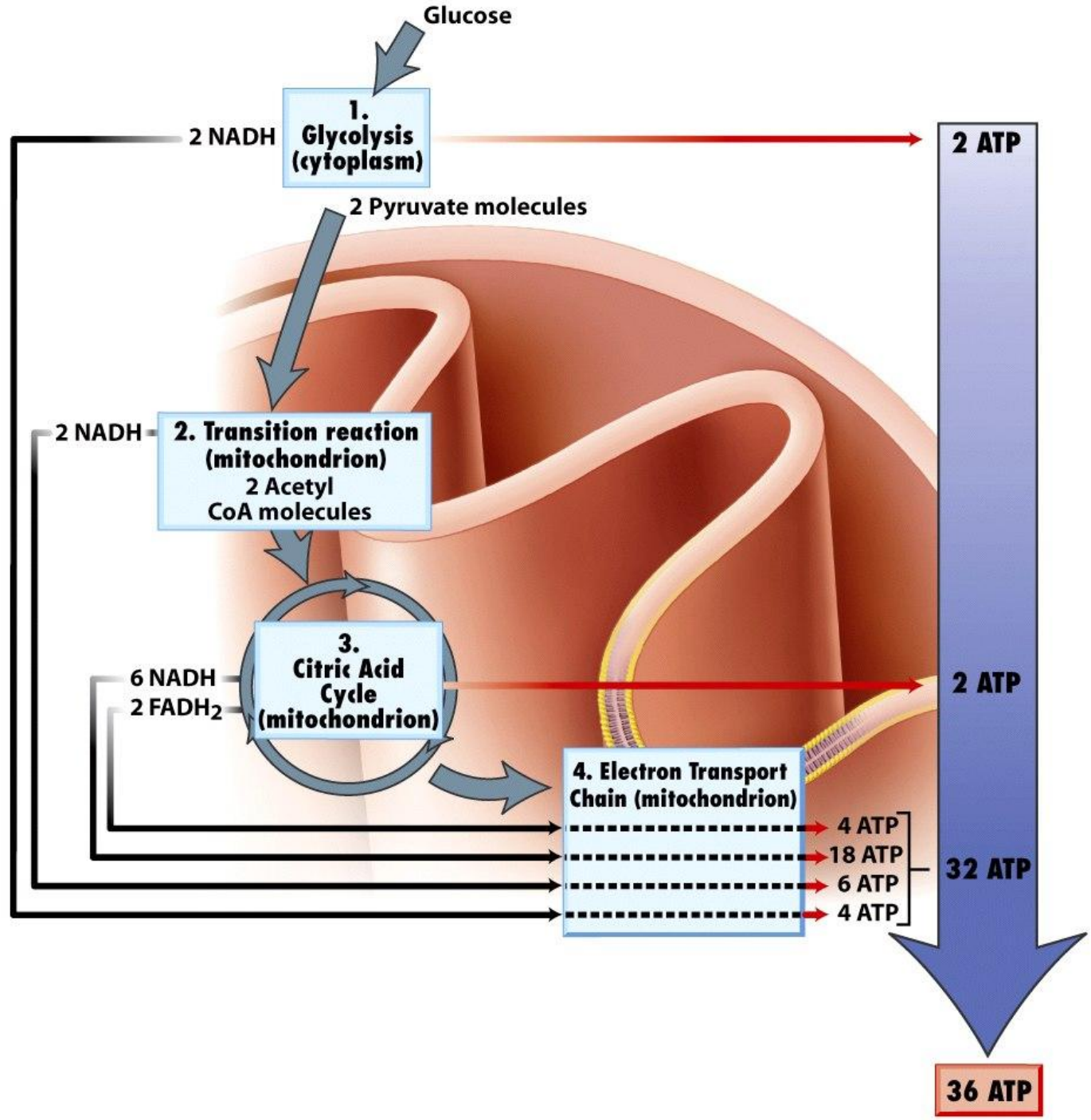



Figure 3-30 Biology of Humans, 2/e

The **Electron Transport Chain** is the final step where the electrons of FADH2 and NADH are transferred from one protein to another, until they reach oxygen, releasing energy that results in 32 ATP.

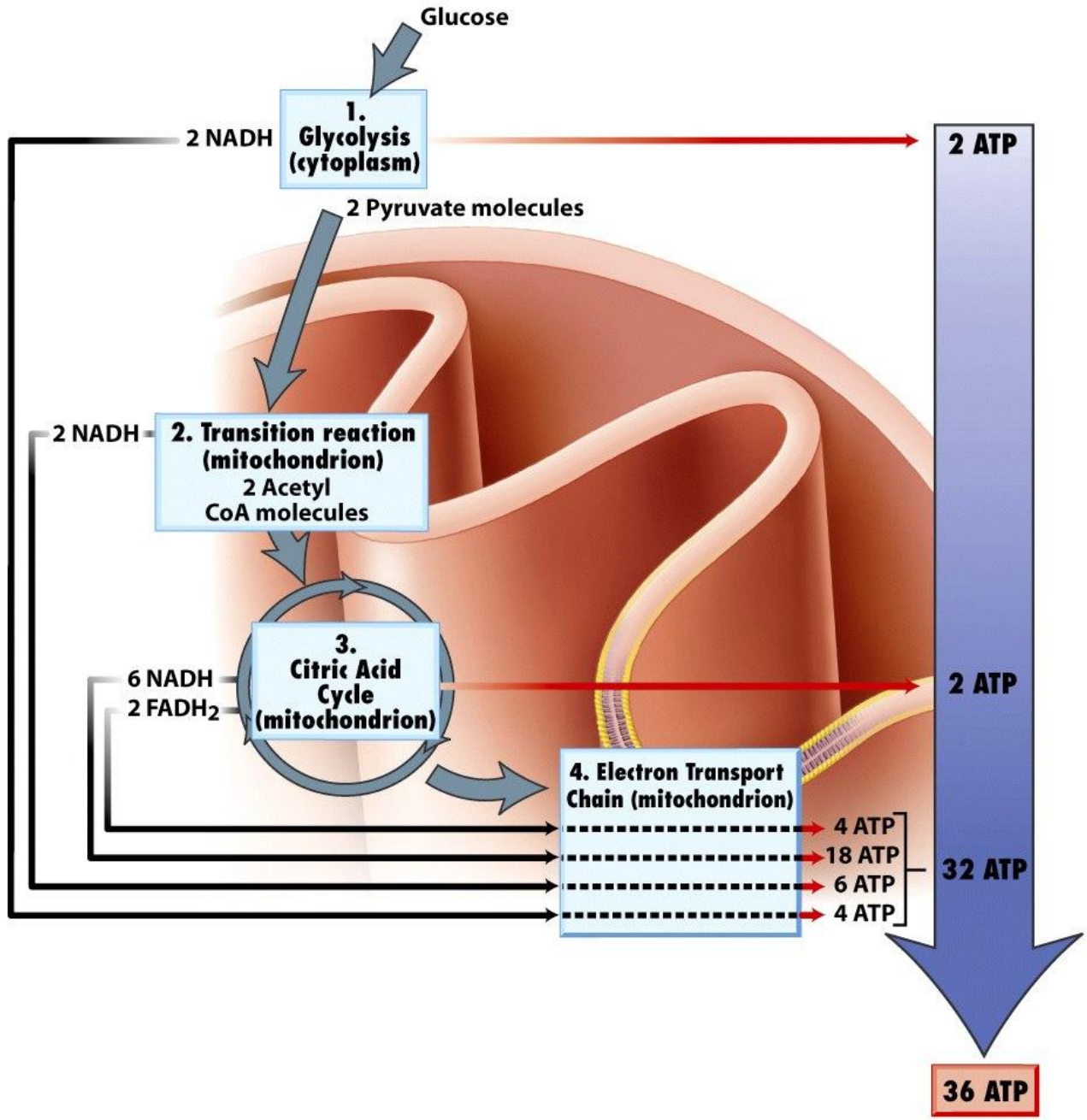
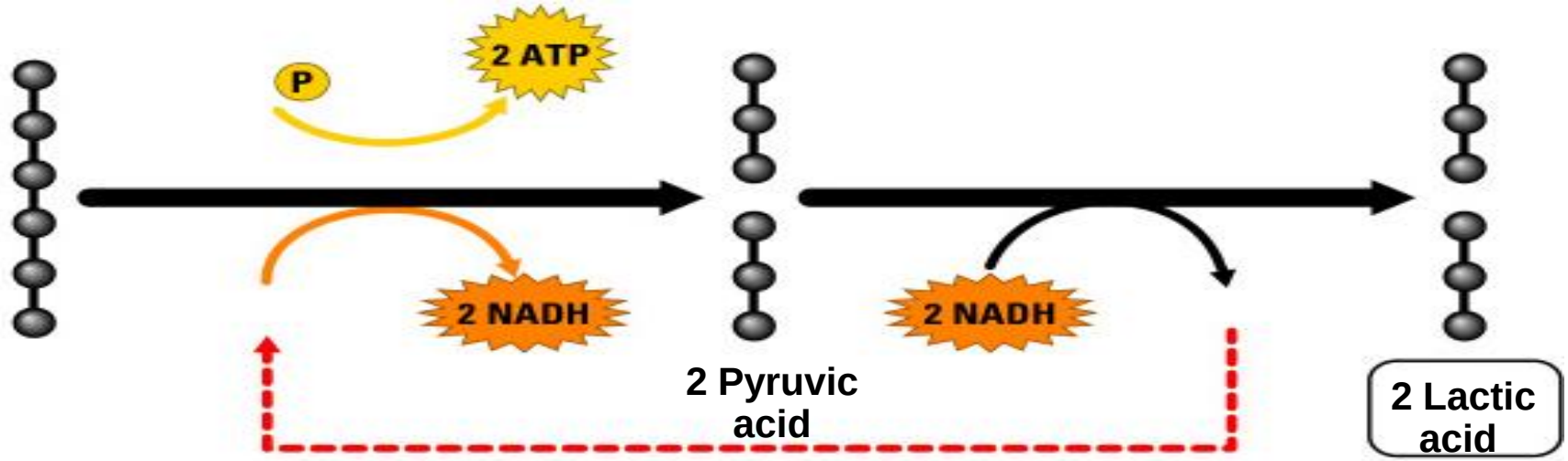



Figure 3-30 Biology of Humans, 2/e

# Fermentation

**Fermentation** is the breakdown of glucose *without* oxygen and takes place entirely in the cytoplasm. It is very inefficient resulting in only two ATP




***Lactic acid fermentation*** takes place in the muscles

Cellular Respiration Explanation!

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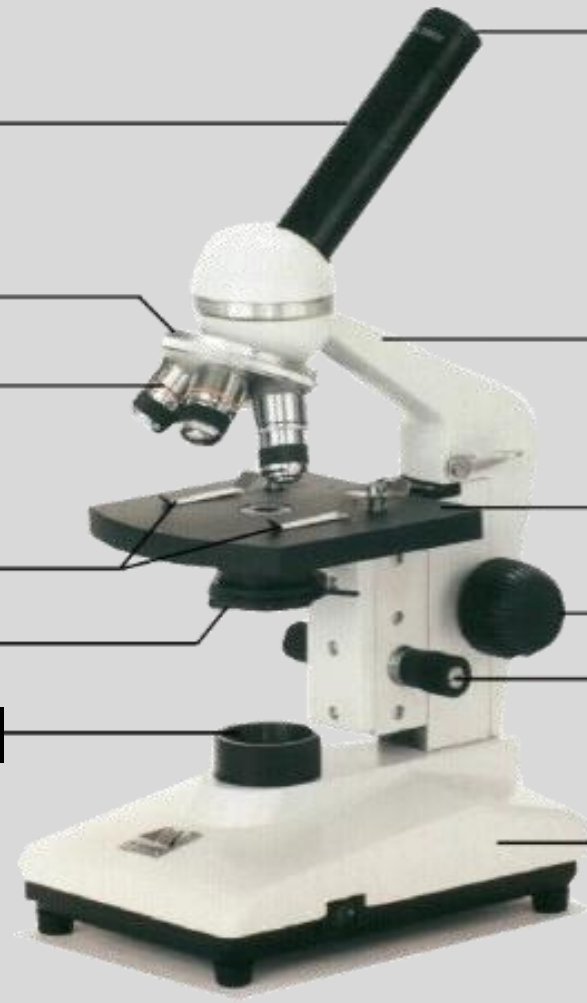
# Microscope Parts



Eyepiece

Body Tube

Revolving Nosepiece

Arm

Objective Lens

Stage

Stage Clips

Coarse Focus

Diaphragm

Fine Focus

Light

Base

# Magnification

Your microscope has 3 magnifications: **Scanning**, **Low** and **High**. Each objective will have the number of the magnification as a whole number (not decimals). In addition to this, the ocular lens (eyepiece) has a magnification.

The total magnification is the:

(eyepiece)ocular lens x objective lens

| | Magnification | Ocular lens | Total Magnification |
|---|---|---|---|
| **Scanning** | 4x | 10x | 40x |
| **Low Power** | 10x | 10x | 100x |
| **High Power** | 40x | 10x | 400x |

# To focus on a specimen:

1. Scanning --> use the coarse knob and then the fine knob
2. Low power --> use coarse knob and then the fine knob
3. High power --> use fine knob only!!!!