# HUMAN ANATOMY I

DENNIS MWENDA

BSc clin med,mcm forensic med

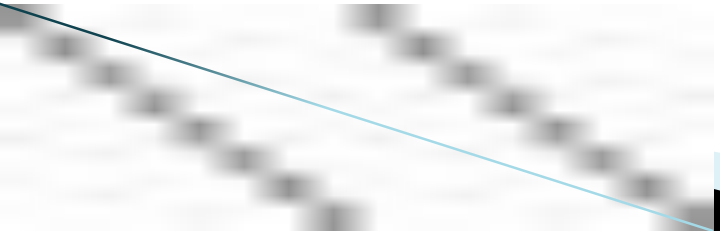
# Outline

Definition

Subdivisions of human anatomy

Anatomical positions, directional terms & surface anatomy

The structure of cells, tissues & organs



# Definition

Anatomy is derived from a greek word “Anatome” meaning “to cut up”.

It is the study of structures that make up the body and their relationships to one another.

3 subdivisions/subspecialties

- Gross or macroscopic anatomy
- Microscopic anatomy
- Developmental anatomy

# Gross anatomy

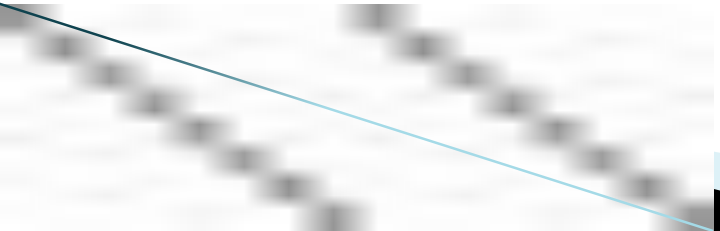
Regional anatomy – studies body parts regionally i.e. all structures in one part of the body (such as the abdomen or leg)

Systemic anatomy – studies functional relationships of organs within a system. Surface anatomy – study of internal structures as they relate to the overlying skin

# Microscopic Anatomy

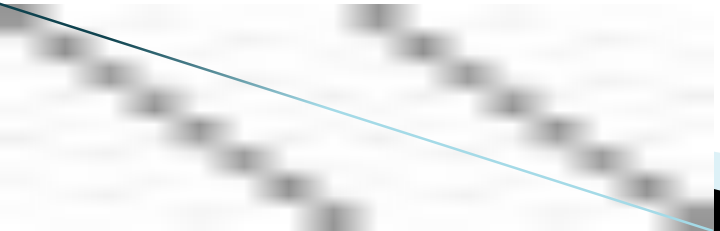
Histology – a science that deals with the study of tissues

Requires the use of a microscope and augmentation of the tissues.



# Developmental Anatomy

- Embryology is the study of developmental changes of the body before birth.



# Levels of structural organization of the body

The human body has different structural levels of organization, starting with atoms that form molecules and compounds

These increase in size and complexity to form cells, tissues, organs and the systems that make up the complete organism

Chemical level – atoms combine to form molecules and compounds (from carbon, Hydrogen, Oxygen, N, P, S)

Cellular level – cells are made of molecules

Tissue level – consists of similar types of cells

Organ level – made up of different tissues

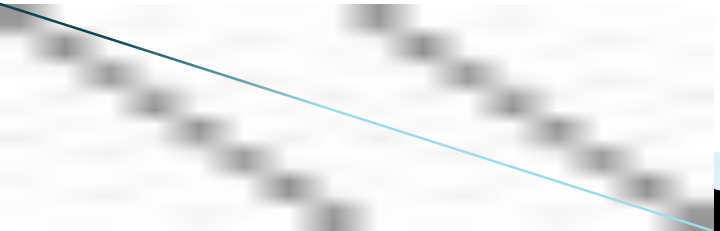
Organ system level – consists of different organs that work closely together

Organismal level – human organism made up of the organ systems

# The cell

The smallest independent unit of life

Basic functions include: growth, metabolism, irritability and reproduction



# Tissue

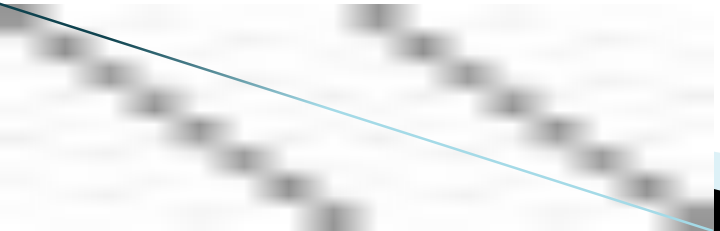
A group of many similar cells and their intercellular substance that have similar embryological origin and function together to perform a specialized bodily activity.

Various tissue of the body are divided into 4 broad categories:

- Epithelial tissue
- Connective tissue
- Nervous tissue
- Muscle tissue

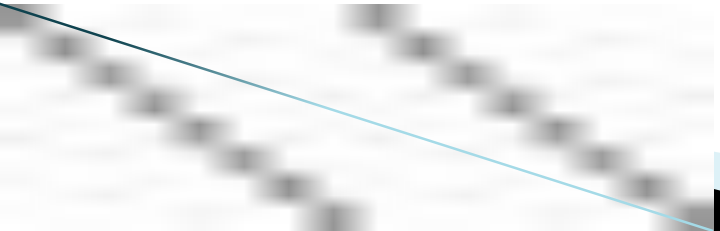
# Organ

An integrated collection of two or more kinds of tissue that work together to perform a specific function



# System

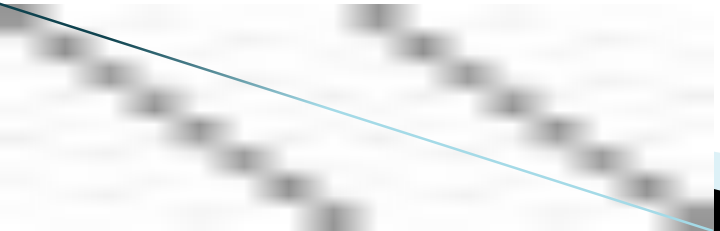
A group of organs that work together to perform a major bodily function



# Anatomical positions

Anatomical positions are universally accepted as starting points for positional references to the body

Anatomical position – the subject stands erect facing the observer, feet slightly apart or together, arms hanging at the sides, palms facing forward, thumbs pointing away from the body.



# Relative directional terms

Anterior (pre-)/posterior (post- or retro-)

Superior (cranial)/inferior (caudal)

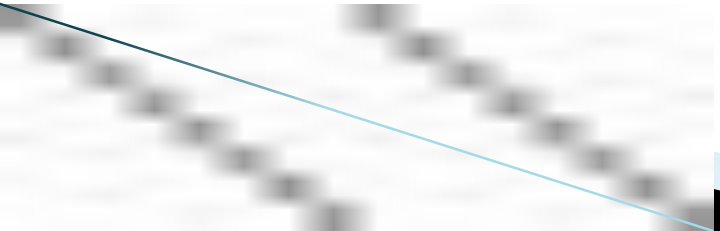
Ventral/dorsal

Medial/lateral

Proximal/distal

Superficial/deep

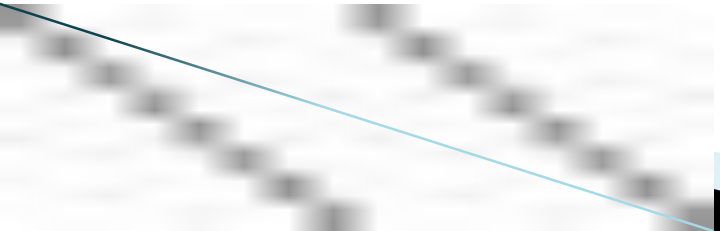
Peripheral – away from the central axis of the body



# Body planes

- Sagittal – divides the body into right and left parts
- Mid-sagittal – sagittal plane that lies on the midline

  Para-sagittal plane – divides body into unequal right and left parts
- Frontal or coronal plane – divides the body into anterior and posterior parts
- Transverse or horizontal (cross section) – divides the body into superior and inferior parts
- Oblique plane – divides body into upper and lower sections



# Body cavities

- Dorsal cavity protects the nervous system, and is divided into two subdivisions
  - Cranial cavity is within the skull and encases the brain
  - Vertebral cavity runs within the vertebral column and encases the spinal cord
- Ventral cavity houses the internal organs (viscera), and is divided into two subdivisions: thoracic and abdominopelvic

# Body cavities…

Thoracic cavity is subdivided into pleural cavities, the mediastinum, and the pericardial cavity

- Pleural cavities – each houses a lung
- Mediastinum – contains the pericardial cavity, and surrounds the remaining thoracic organs
- Pericardial – encloses the heart

The abdominopelvic cavity is separated from the superior thoracic cavity by the dome-shaped diaphragm. It is composed of two subdivisions:

- Abdominal cavity – contains the stomach, intestines, spleen, liver, and other organs
- Pelvic cavity – lies within the pelvis and contains the bladder, reproductive organs, and rectum

# Ventral body cavity membranes

Parietal serosa covering the body walls

Visceral serosa covering the internal organ

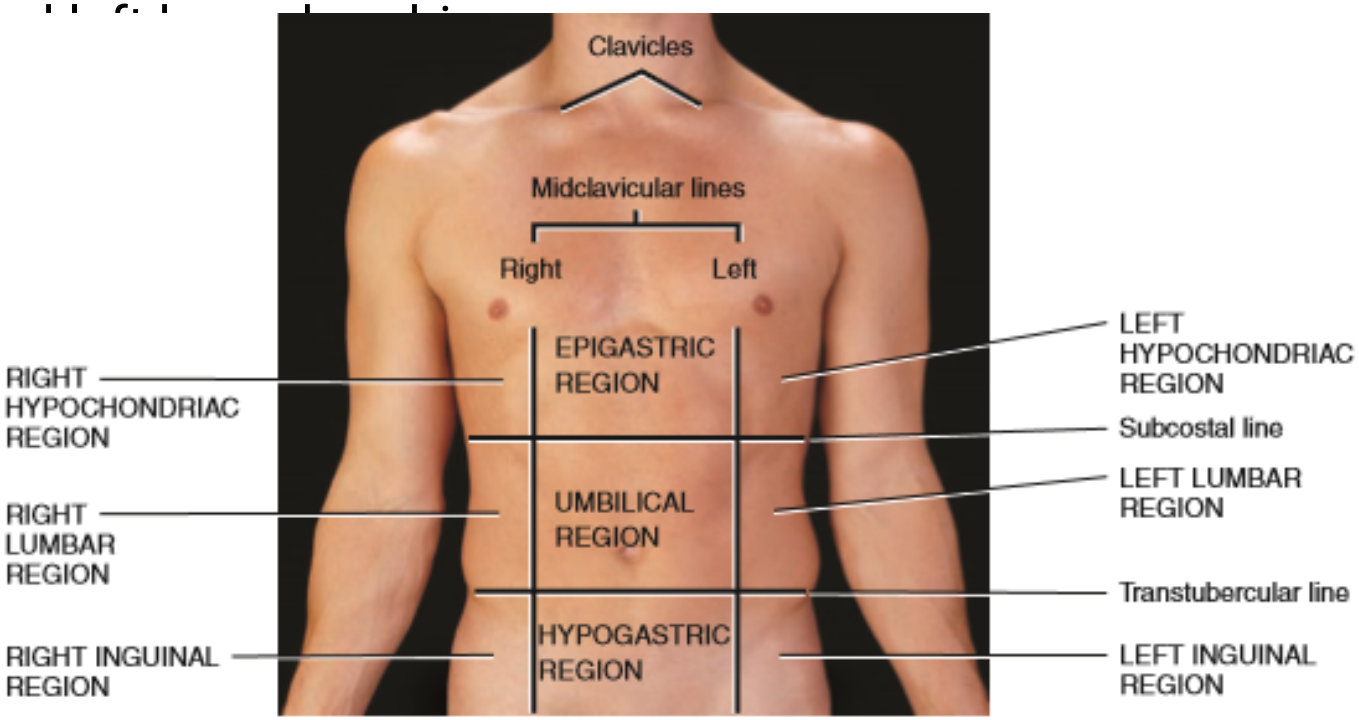
Serous fluid separates the serosae.

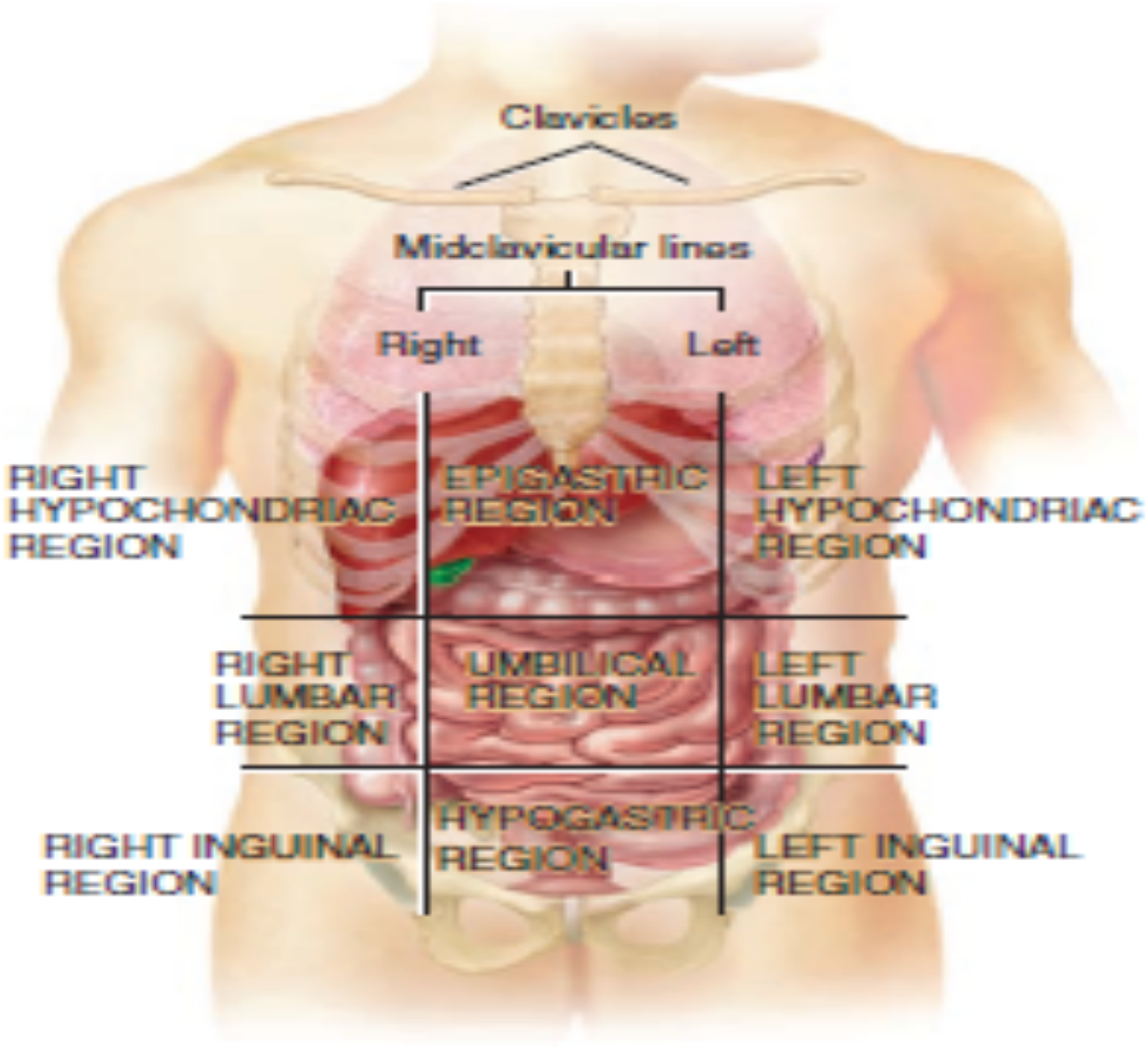
Other body cavities include:

- Oral and digestive – mouth and cavities of the digestive organs
- Nasal –located within and posterior to the nose
- Orbital – houses the eyes
- Middle ear – contain bones (ossicles) that transmit sound vibrations
- Synovial – joint cavities

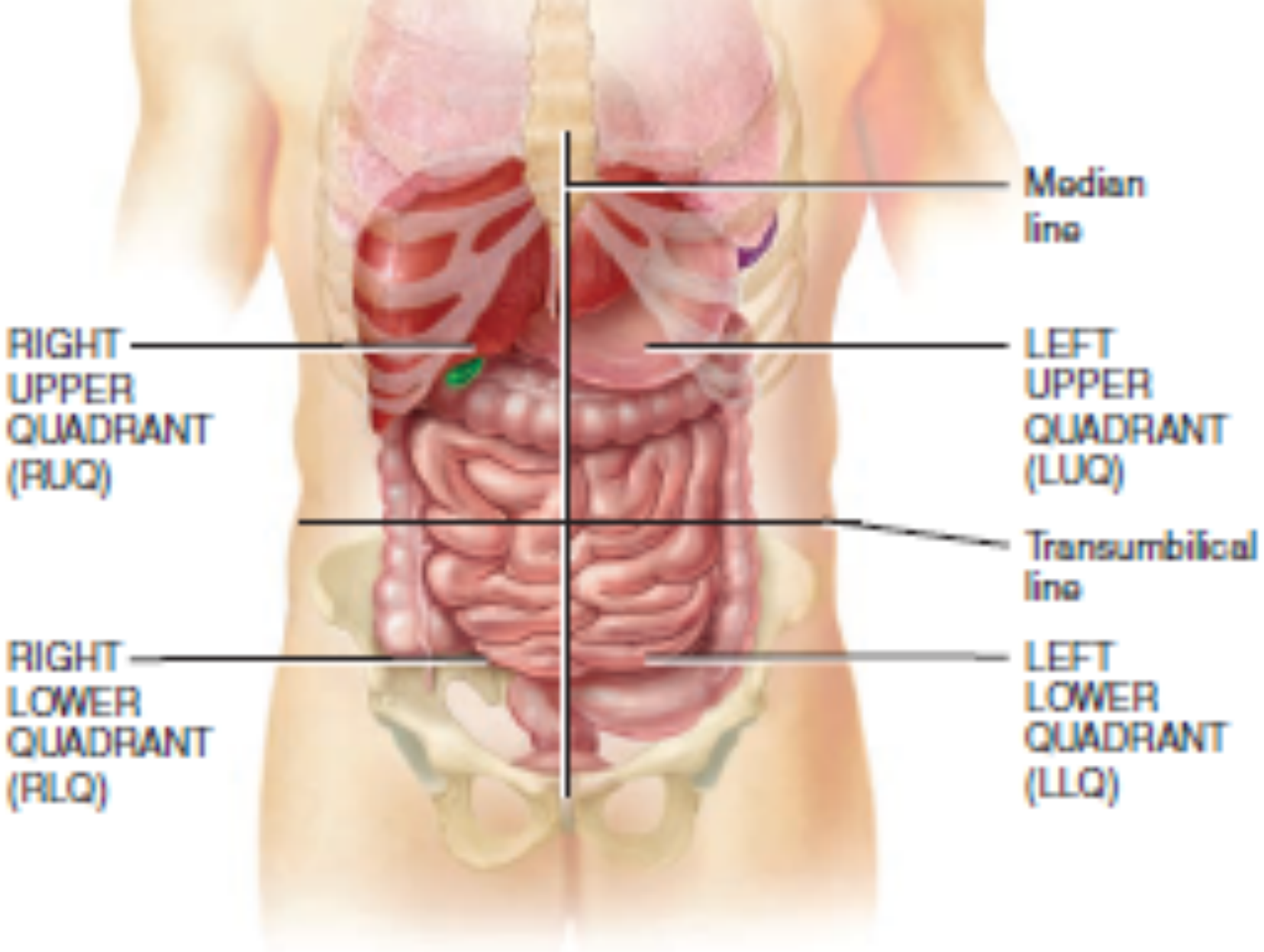
# Abdominopelvic regions

- Umbilical
- Epigastric
- Hypogastric or suprapubic
- Right and left iliac or inguinal
- Right and left lumbar
- Righ






(b) Anterior view showing location of abdominopelvic regions




(c) Anterior view showing location of abdominopelvic quadrants

# The cell

## Structure of cells, tissues & organs

Smallest living part of the body

The basic morphological and functional unit

During the process of growth, cellular multiplication and differentiation occurs.

Cellular differentiation is the by which primitive cells undergo gradual morphological & chemical modifications in cytoplasm and nucleus, resulting in more functionally specialized cell types

# Cell structure

- Plasma Membrane
- Cytoplasm
- Organelles
  - Nucleus
  - Ribosomes
  - endoplasmic reticulum (ER)
  - Golgi complex (apparatus)
  - Mitochondria
  - Lysosomes
  - Peroxisomes

# Structure of cells, tissues & organs….

Cell structure…..

- Cytoskeleton, Cilia, Flagella
- Inclusions
- Extracellular matrix

# The plasma membrane (plasmalemma)

- Bounds/encloses all living cells, forming a dynamic interface between the internal and external cellular environment
- Consists of lipids (phospolipids & cholesterol), proteins & surface associated polysaccharides and oligosaccharides
- Functions include:
  - Acts as a selective barrier, regulating/facilitating transport of materials into and out of the cell.
  - Plays a role in the way the cell perceives and interacts with the environment.
  - Maintains cell structure and intracellular climate

# The plasma membrane…….

## Chemical Composition

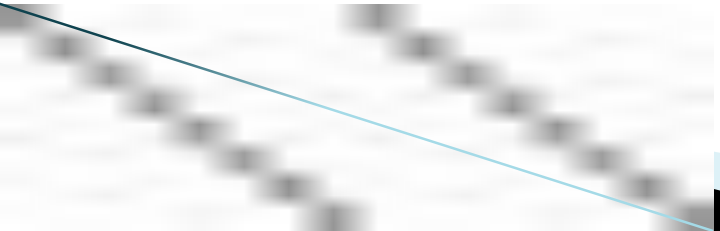
80% phospholipids

"head" region of molecule is hydrophilic

"tail" region of molecule is hydrophobic

10% proteins (peripheral and integral)

10% cholesterol, glycolipids, carbohydrates



# The plasma membrane…….

## Structure

Phospholipid bilayer - two layers of phospholipids with "head" regions pointing inward and outward while "tail" regions intermingle in the middle of the sandwich.

Integral membrane proteins

Float in or completely across lipid bilayer

Act as selective channels for transport and receptor sites for messengers (hormones)

Peripheral membrane proteins

Lie on inner/outer surface of lipid bilayer

Many have enzymatic roles

# Cytoplasm (cytosol)

## Composition and structure

- 90% water;  10% protein, carbohydrate, lipid, salts & colloids
  - Jelly-like fluid surrounding the nucleus
  - Organelles and inclusions embedded here
  - Criss-crossed by cytoskeleton that holds cell shape

## Functions

- Site of many enzyme controlled reactions
- Site of both synthesis and degradation reactions
- Intermediate area for storage and cell transport

# Organelles

## The nucleus

### Structure and composition

Nuclear membrane - double lipid bilayer with circular gaps/pores

Nucleoplasm (karyolymph) – proteins, metabolites & ions

Deoxyribose Nucleic Acids (DNA)

a. Chromatin – coiled strands of DNA bound to basic proteins

b. Chromosomes - condensed DNA, only when dividing

Nucleolus – rich in RNA & basic proteins. Synthesizes ribosomal RNA before cytoplasmic transfer.

### Primary Functions

House and protect hereditary material (DNA)

Copy DNA to RNA so proteins can be manufactured

Produce ribosomal RNA (rRNA) to make ribosomes

# Organelles

Ribosomes – made up of rRNA and associated proteins. Free or attached. Only site for protein synthesis (read mRNA from nucleus)

Endoplasmic reticulum (ER) – network of cisterns near nucleus. Provide large surface area for cellular reactions. Also transport, store & package materials. Rough ER – protein synthesis, storage, transport to golgi apparatus for packaging. Smooth ER – store calcium (muscle )cells, detoxify harmful compounds (liver) etc.

# Organelles….

## Golgi Complex (Apparatus)

Structure – cisternae lined up in stacks next to nucleus with cis, medial, and trans- parts.

Process, sort, package, deliver proteins

cis - closest to ER, receives new proteins

medial - alters protein to functional form

trans - forms secretory granules for protein release

digestive enzymes

antibodies

secretory glands

extracellular matrix material

# Organelles….

## Mitochondria

Two-membrane structure

a. outer mitochondrial membrane

b. inner mitochondrial membrane (cristae).

Matrix - within the inner membrane

Primary Functions

Powerhouse of the cell

Glucose broken down in cytoplasm and converted to useable energy (ATP)

## Varied distribution

low energy required - fewer mitochondria

high energy required - more mitochondria

muscle cells, liver cells, kidney tubule cells

# Organelles….

## Lysosomes

Are single membrane enclosed spheres.

Two types -

primary lysosome - bud-off from Golgi complex

secondary lysosome - when fused with a vacuole

Primary functions

breakdown (digestion) of compounds and old parts

autophagy - "self eating" reuse old organelles

autolysis - "self destruction" of entire cell

release digestive enzymes to outside

a. sperm entering egg during fertilization

b. during repair of bodily injury

c. osteoclasts - during bone growth

# Organelles….

## Peroxisomes

Small, single membrane enclosed spheres

Function: breakdown hydrogen peroxide (toxic to cells), facilitated by catalase.

## Cell inclusions

Conglomeration of molecules of same type

Examples include:

melanin - pigment in skin, hair, eyes

glycogen - glucose storage - liver and muscles

lipids - stored in fat cells

# Cytoskeleton

A. Microfilaments

6 nanometers in diameter

made up of subunits called actin (myosin in muscle)

support and cell shape

movement - muscle contraction, white blood cells (phagocytes)

B. Intermediate filaments

8-12 nanometers in diameter

Support, shape, some intracellular movement

Best studied: in nerve cells (neurons) - possible role in

Alzheimer's disease, other neuronal disorders

# Cytoskeleton….

## Microtubules

- Approx. 24 nanometers in diameter. Made up of subunits called tubulin
- Involved in intracellular transport ….. move organelles around like a highway
- Involved in amoeboid motion of cells (phagocytes)
- Chief components of cilia and flagella

## Cilia and flagella

- Both consist of microtubules
- Flagella very large for cell locomotion (sperm)
- Cilia very small, fingerlike projections
  - epithelium of respiratory tract
  - lining of digestive tract (intestinal villi)

# Extracellular matrix

Types

- interstitial (extracellular) fluid (including tissue fluid)
- secretory material (mucus, saliva, sweat)
- **extracellular matrix** (binding cells into tissue)
- Amorphous extracellular components (jelly-like)
  - hyaluronic acid - binding, lubrication, shape
  - chondroitin sulfate - cartilage, bone, vessels
  - dermatin sulfate - skin, tendons
  - keratin sulfate - bone and cornea
- Fibrous extracellular components (thread-like)
  - collagen - primary subunit of fibrous components
  - collagenous fibers - bone, cartilage, tendon, ligaments
  - reticular fibers - fat, muscle, nerve, vessels
  - elastic fibers - (elastin) skin and blood vessels

# CELL ANATOMY AND CHEMISTRY OF LIFE

**CMS SEPT 2016 CLASS**

**LECTURER**

**KAUSYA J.J.M.**

**KMTC-MWINGI**

# Objectives

By the end of the lesson the learner should be able to;

i. define terms used in cell anatomy

ii. Explain cell structure (morphology)

iii. Describe the morphology various organelles

iv. Appreciate the cell as the basic building block of human body .

V. Demonstrate how cell anatomy relevant in diagnose and management of diseases.

# WHY STUDY THE CELL

The cell is the basic unit of life and disease conditions affect specific cells-eg malaria affect red blood cells, diabetes –beta cells of the pancrease that produce insulin

Interventions in terms of drugs target specific cells – eg antibiotics target bacterial cells or aspects of the same.

Understanding the cell structure helps us develop and carry out interventions that are efficient, and appropriate to sustain life, also in genetic engineering.

The atom is the smallest particle of an element which can exist as a stable entity. An element is a chemical substance whose atoms are all of the same type; e.g. iron contains only iron atoms. Compounds contain more than one type of atom; for instance, water is compound containing both hydrogen and oxygen atoms(H2O). An element is a substance made of only one type of atom (therefore, an atom is the smallest part of an element). There are 92 naturally occurring elements in the world around us.

Examples are hydrogen (H), iron (Fe), oxygen (O), calcium (Ca), nitrogen (N), and carbon (C). In nature, an element does not usually exist by itself but rather combines with the atoms of other elements to form compounds.

## Atomic structure

Atoms are made up of three main types of particles.

Protons are particles present in the nucleus or central part of

Atoms are the smallest parts of an element that have the characteristics of that element. An atom consists of three major subunits or particles: protons, neutrons, and electrons. A proton has a positive electrical charge and is found in the nucleus (or center) of the atom. A neutron is electrically neutral (has no charge) and is also found in the nucleus. An electron has a negative electrical charge and is found outside the nucleus orbiting in what may be called an electron cloud or shell around the nucleus. The number of protons in an atom gives it its atomic number. Protons and neutrons have mass and weight; they give an atom its atomic weight. In an atom, the number of protons () equals the number of electrons (); therefore, an atom is electrically neutral. The electrons, however, are important in that they may enable an atom to connect, or bond, to other atoms to form molecules. A molecule is a combination of atoms (usually of more than one element) that are so tightly bound together that the molecule behaves as a single unit. Each atom is capable of

The first, or innermost, energy level can contain a maximum of two electrons and is the considered stable. The second energy level is stable when it contains its maximum of eight electrons. The remaining energy levels, more distant from the nucleus, are also most stable when they contain eight electrons, or a multiple of eight. A few atoms (elements) are naturally stable, or uninterested in reacting, because their outermost energy level already contains the maximum number of electrons. The gases helium and neon are examples of these stable atoms, which do not usually react with other atoms. Most atoms are not stable, however, and tend to gain, lose, or share electrons in order to fill their outermost shell. By doing so, an atom is capable of forming one or more chemical bonds with other atoms. In this way, the atom becomes stable, because its outermost shell of electrons has been filled. It is these reactive atoms that are of interest in our study of anatomy and physiology.

The human body is a precisely structured container of chemical reactions. The body consists of trillions of atoms in specific arrangements and thousands of chemical reactions proceeding in a very orderly manner. The keys to understanding human consciousness and self awareness are still beyond our grasp. We do not yet know what enables us to study ourselves—no other animals do, as far as we know—but we have accumulated a great deal of knowledge about what we are made of and how it all works. Some of this knowledge makes up the course you are about to take, a course in basic human anatomy and physiology. Pathophysiology is the study of disorders of functioning, and a knowledge of normal physiology makes such disorders easier to understand.

Anatomy is the study of body structure, which includes size, shape, composition, and perhaps even coloration. Physiology is the study of how the body functions. The physiology of red blood cells, for example, includes what these cells do, how they do it, and how this is related to the functioning of the rest of the body. Physiology is directly related to anatomy. For example, red blood cells contain the mineral iron in molecules of the protein called hemoglobin; this is an aspect of their anatomy. The presence of iron enables red blood cells to carry oxygen, which is their function. All cells in the body must receive oxygen in order to function properly, so the physiology of red blood cells is essential to the physiology of the body as a whole.

# CHEMICALS

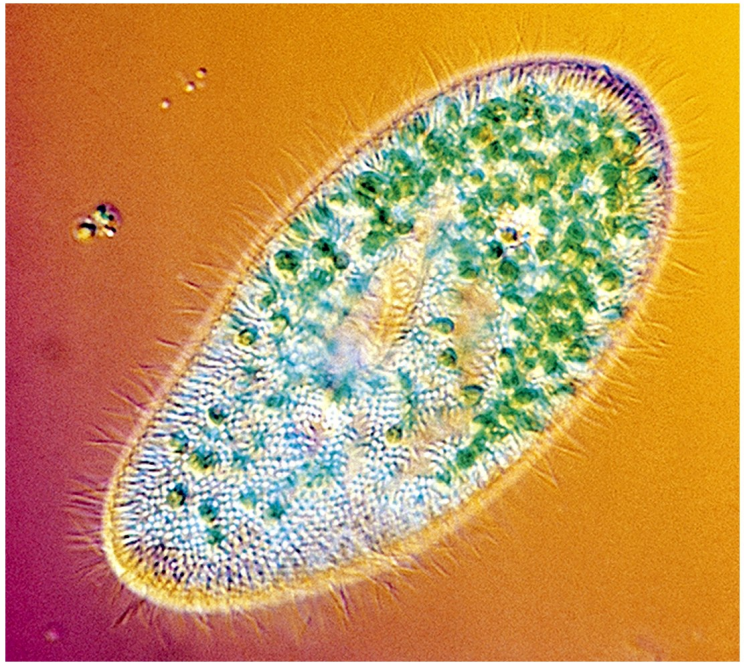
The chemicals that make up the body may be divided into two major categories: inorganic and organic. Inorganic chemicals are usually simple molecules made of one or two elements other than carbon (with a few exceptions). Examples of inorganic chemicals are water ($H_2O$); oxygen ($O_2$); one of the exceptions, carbon dioxide ($CO_2$); and minerals such as iron (Fe), calcium (Ca), and sodium (Na). Organic chemicals are often very complex and always contain the elements carbon and hydrogen. In this category of organic chemicals are carbohydrates, fats, proteins, and nucleic acids.

# Cells

Smallest living unit

Most are microscopic.

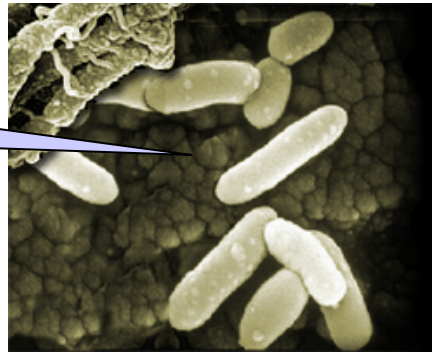
A cell is the smallest unit that is capable of performing life functions



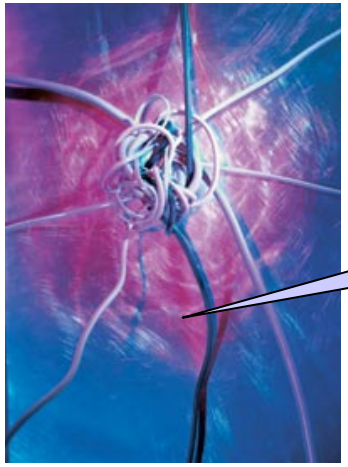
# Examples of Cells

Amoeba Proteus

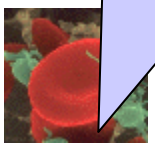
Plant Stem



Bacteria



Nerve Cell



Red Blood Cell

# History of Cell Theory

i. mid 1600s – Anton van Leeuwenhoek

Improved microscope, observed many living cell

ii. mid 1600s – Robert Hooke

Observed many cells

iii. 1850 – Rudolf Virchow

Proposed that all cells come from existing cells

iv. Cells were discovered in 1665 by Robert Hooke.

v. Early studies of cells were conducted by

- Mathias Schleiden (1838)
- Theodor Schwann (1839)

vi. Schleiden and Schwann proposed the Cell Theory.

1. All organisms consist of 1 or more cells.
2. Cell is the smallest unit of life.
3. All cells come from pre-existing cells.

Principles of Cell **Theory**

All living things are made of cells

Smallest living unit of structure and function of all organisms is the cell

All cells arise from preexisting cells

(this principle discarded the idea of spontaneous generation)

All cells today represent a continuous line of descent from the first living cells.

Microscopes are required to visualize cells.

i. **Light microscopes** can resolve structures that are 200nm apart.

ii. **Electron microscopes** can resolve structures that are 0.2nm

# Characteristics of All Cells

i. A surrounding membrane
ii. Protoplasm – cell contents in thick fluid
iii. Organelles – structures for cell function
iv. Control center with DNA

**Cell Types**

1. Prokaryotic
2. Eukaryotic

**Prokaryotic**

Do not have structures surrounded by membranes

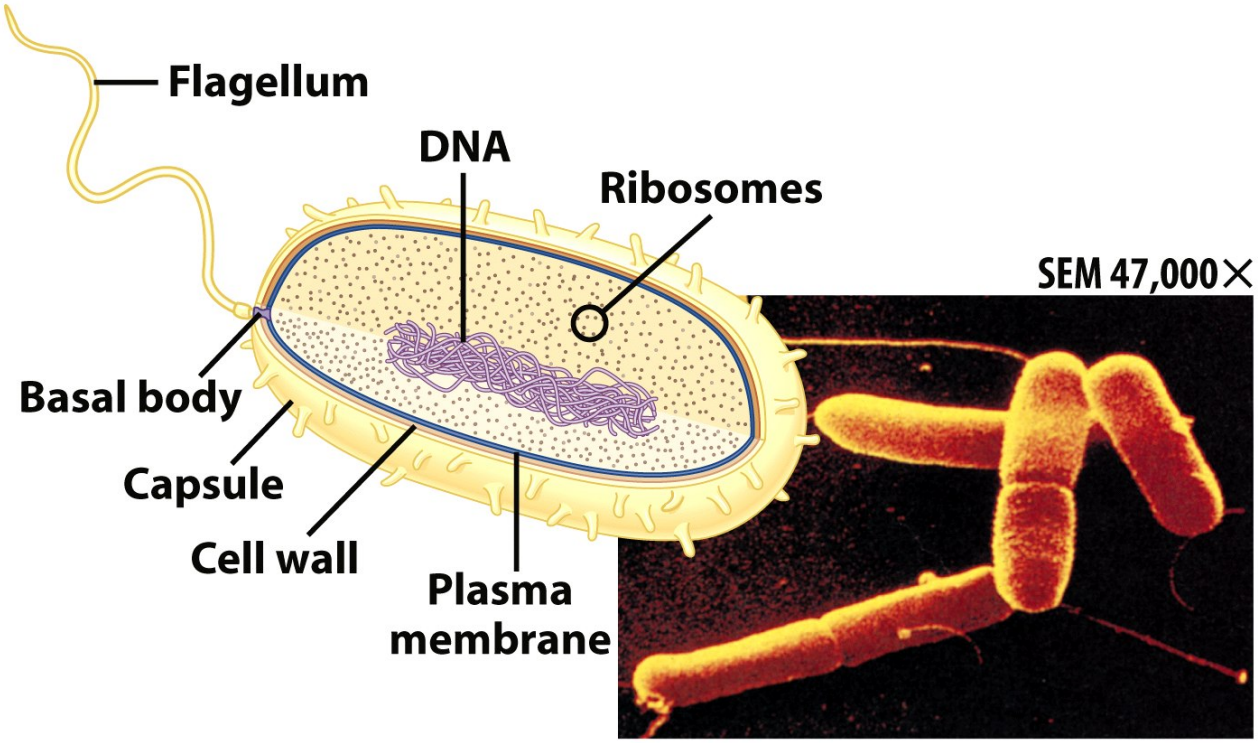
Few internal structures

One-celled organisms, Bacteria

# Prokaryotic Cells

First cell type on earth

Cell type of Bacteria and Archaea

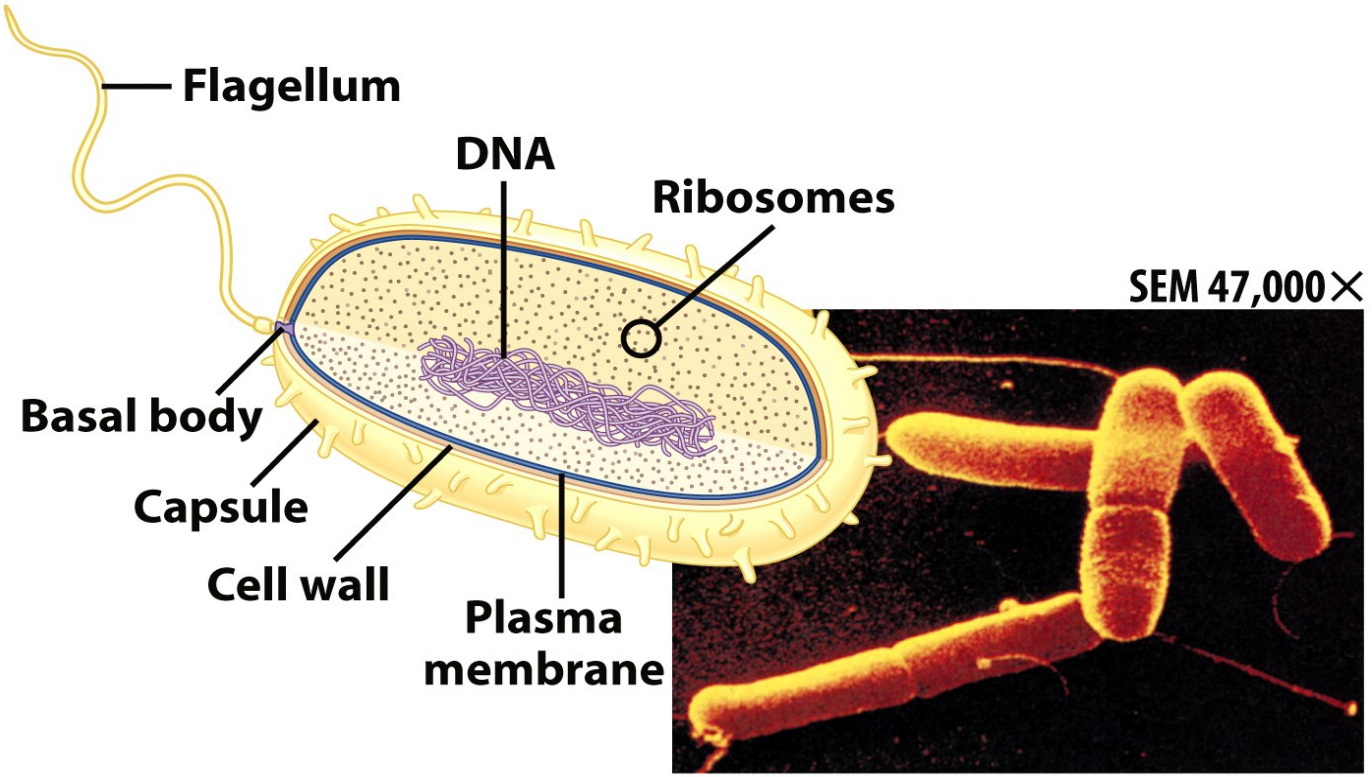


# Prokaryotic Cells

No membrane bound nucleus

Nucleoid = region of DNA concentration

Organelles not bound by membranes



# Eukaryotic Cells

1. Include fungi, protists, plant, and animal cells

2. compartmentalize many cellular functions within **organelles** and the **endomembrane system ie**

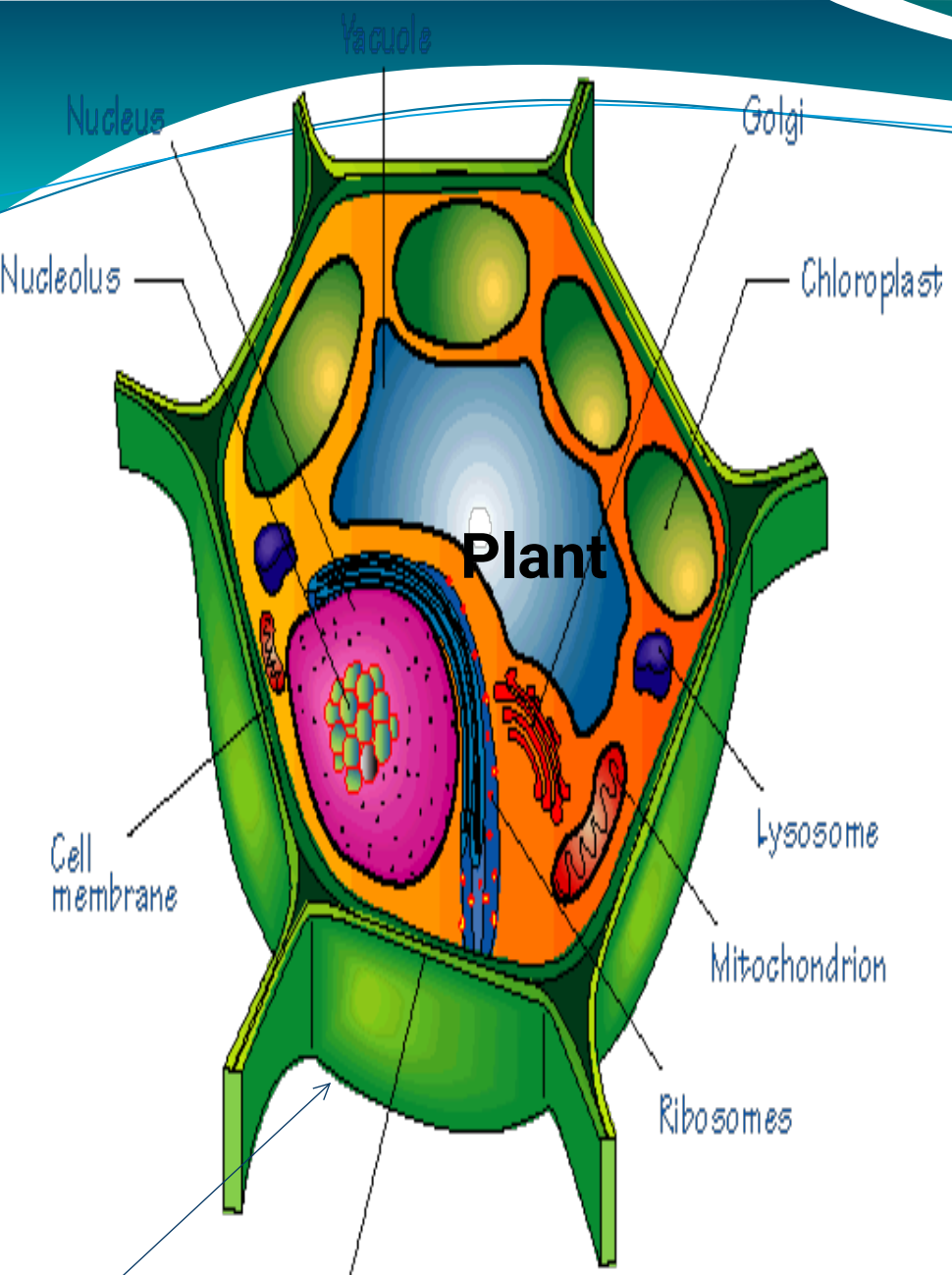
-Contain *organelles* surrounded by membranes

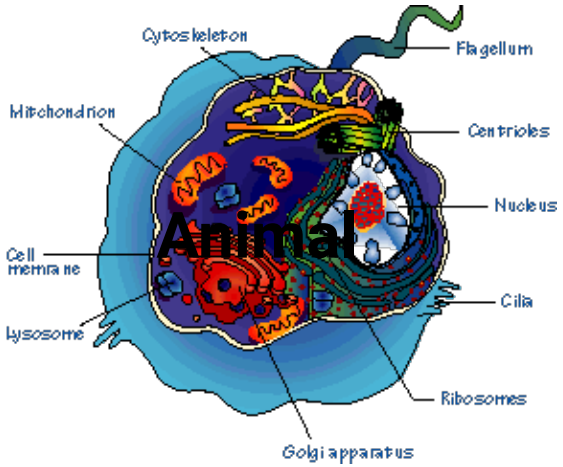
3 . Most living organisms

4. possess a membrane-bound nucleus

-are more complex than prokaryotic cells

5. possess a **cytoskeleton** for support and to maintain cellular structure




Plant (lt)…….. And,…….. animal (rt) cells

# INTRODUCTION

The cell is the basic unit of structure and function in living things. Cells vary in their shape size, and arrangements but all cells have similar components, each with a particular function.

Some of the 100 trillion of cells make up human body.

All human cell are microscopic in size, shape and function.

The diameter range from 7.5 micrometer (RBC) to 150 mm (ovum).

Cell is defined as the fundamental living unit of any organism.

-Cell is important to produce energy for metabolism (all chemical reactions within a cell)

-Cell can mutate (change genetically) as a result of accidental changes in its genetic material (DNA).

Cytology: the study of the structure and functions of cells.

# Cell Parts

n

Organelles

=components of cell

.

# cell organelles

1. Cell membrane
2. Cytoplasm
3. Nucleus
4. Mitochondria
5. Endoplasmic reticulum
6. Ribosomes
7. Lysosomes
8. Vacuoles
9. Golgi bodies
10. Chloroplast

# Endomembrane System

**Endomembrane system is**

-a series of membranes throughout the cytoplasm

-divides cell into compartments where different cellular functions occur

1. endoplasmic reticulum
2. Golgi apparatus
3. lysosomes

# Membrane Junctions

Tight junction – impermeable junction that encircles the cell & prevents leakage

– Blood brain barrier

- Skin

Desmosome – anchoring junction scattered along the sides of cells. Prevents tissues from fraying

Stomach, uterus , bladder

Gap junction – allows chemical substances to pass between cells

Heart

# Cell structure

1) THE CELL (PLASMA) MEMBRANE

The cell membrane is a thin, dynamic membrane that encloses the cell and controls what enters and leaves the cell.

Fluid Mosaic Model

composed of a double layer (bilayer) of phospholipid molecules with many protein molecules dispersed within it

# Fluid Mosaic Model

a. The surfaces of the membrane are "hydrophilic" due to the polar phosphate heads;

b. The internal portion of the membrane is "hydrophobic" due to the non-polar fatty acid tails;

c. The membrane proteins also have both hydrophilic and hydrophobic

d. **PLASMA MEMBRANE**

hydrophillic phosphate head,

hydrophobic fatty acid tails

**Chemical attractions are the forces that hold membranes together**

# Function of plasma membrane

Serves as boundary of the cell.

Serve as markers that identify the cells.

Play significant role in transportation.

Cell recognition proteins-allow cell to recognize other cells.

Membrane proteins-

- Some membrane proteins have carbohydrates attached to them, forming glycoproteins that act as identification markers
- Some membrane proteins are receptors that react to specific chemicals, sometimes permitting a process called signal transduction

# Cytoplasm

Is a gel-like matrix of water, enzymes, nutrients, wastes, and gases and contains cell structures (organelles).

Fluid around the organelles called cytosol.

Most of the cells metabolic reactions occur in the cytoplasm.

Viscous fluid containing organelles

components of cytoplasm

- Interconnected filaments & fibers
- Fluid = cytosol
- Organelles (not nucleus)
- storage substances

**NB: Structures found inside the cell are called organelles.**

# Cytoskeleton

Filaments & fibers

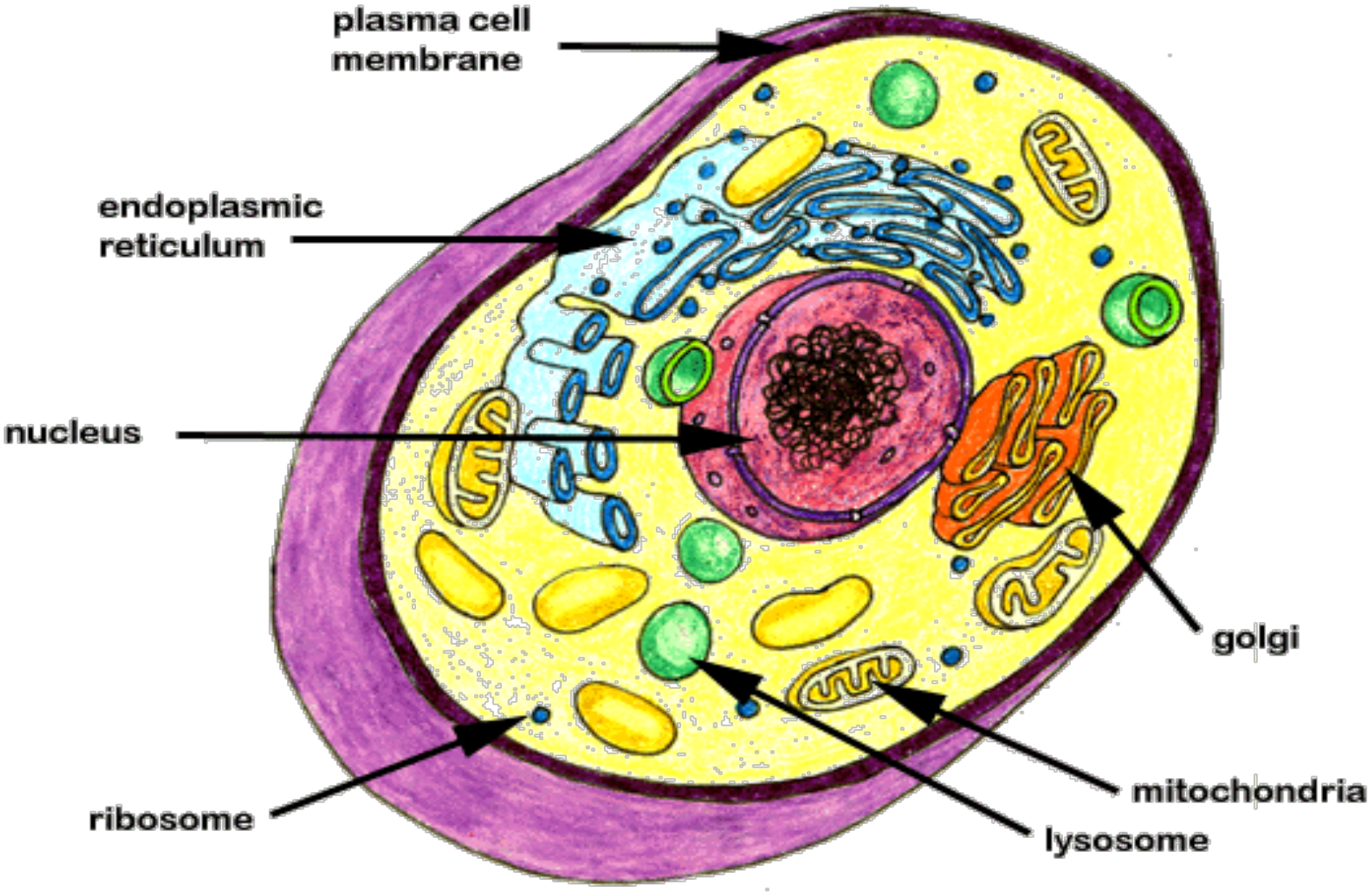
Made of 3 fiber types

- Microfilaments
- Microtubules
- Intermediate filaments

3 functions:

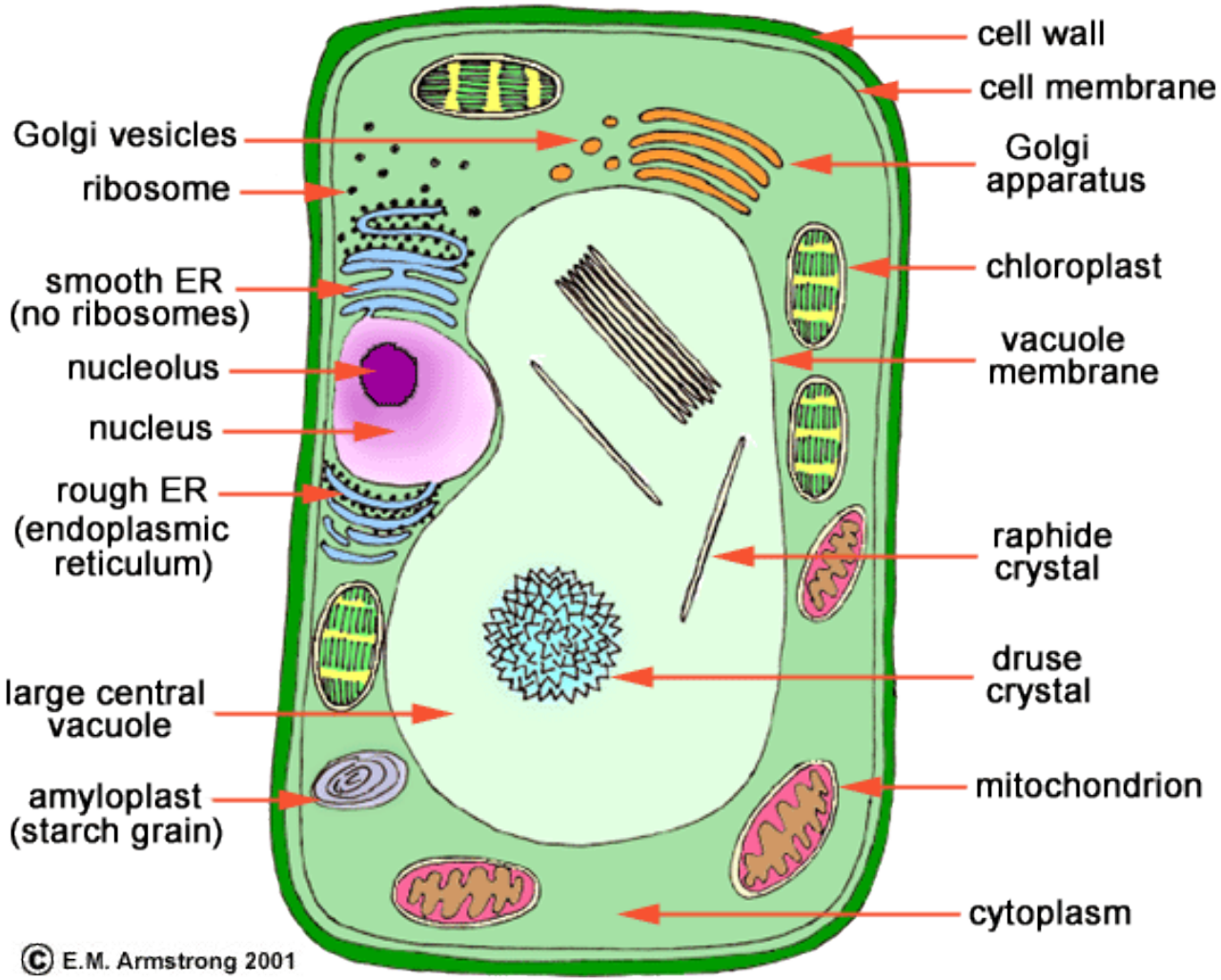
- mechanical support
- anchor organelles
- help move substances

# "Typical" Animal Cell




*http://web.jjay.cuny.edu/~acarpi/NSC/images/cell.gif*

# "Typical" Plant Cell




*http://waynesword.palomar.edu/images/plant3.gif*

# Phospholipids

Interacts with water

Polar;

Hydrophylic head

Non polar;

Hydrophobic tail

# Membrane Proteins

1. Channels or transporters

   Move molecules in one direction

2. Receptors

3. Glycoproteins

   Identify cell type

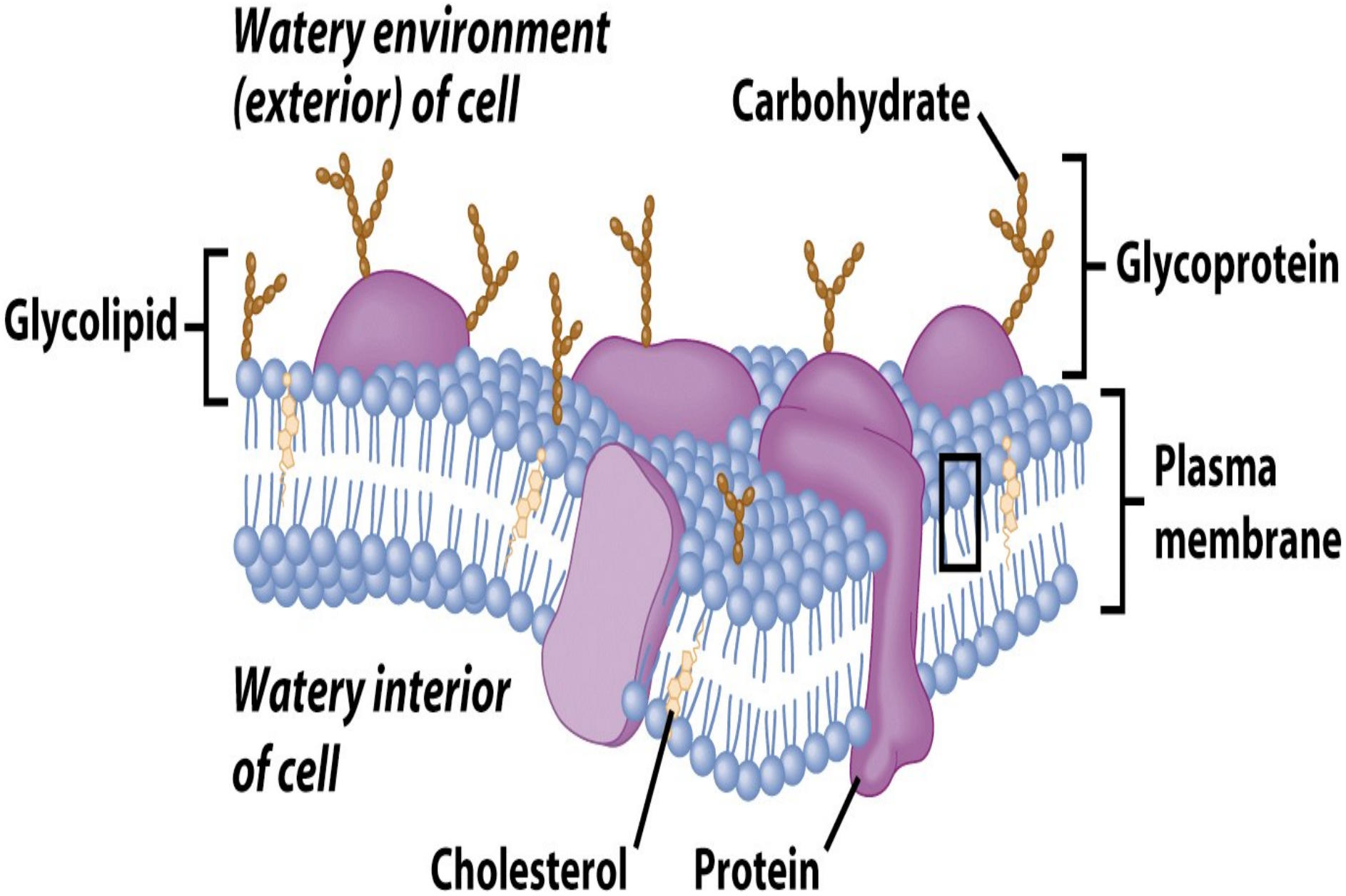
4. Enzymes

   Catalyze production of substances

   Recognize certain chemicals

   (see diag. below)

# Membrane Proteins



# Cilia & Flagella

Provide motility

Cilia

- Short
- Used to move substances outside human cells

Flagella

- Whip-like extensions
- Found on sperm cells

Basal bodies like centrioles

microvilli

# **Nucleus** : enclosed by nuclear membrane

Directs cell activities

Separated from cytoplasm by nuclear membrane

Contains genetic mater

Contains:-

i. Hereditary material

ii. Chromosomes

DNA

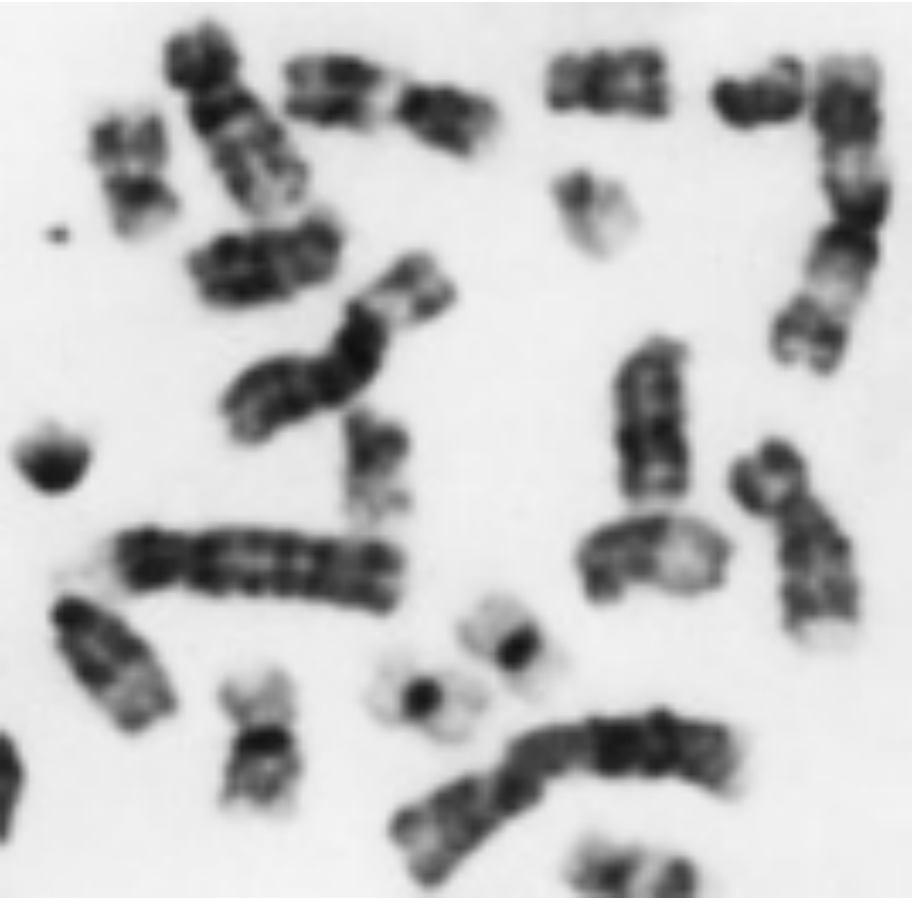
Proteins

Form for cell division

iii. Chromatin

iv - DNA

# Chromosomes



In nucleus

Made of DNA

Contain instructions for traits & characteristics

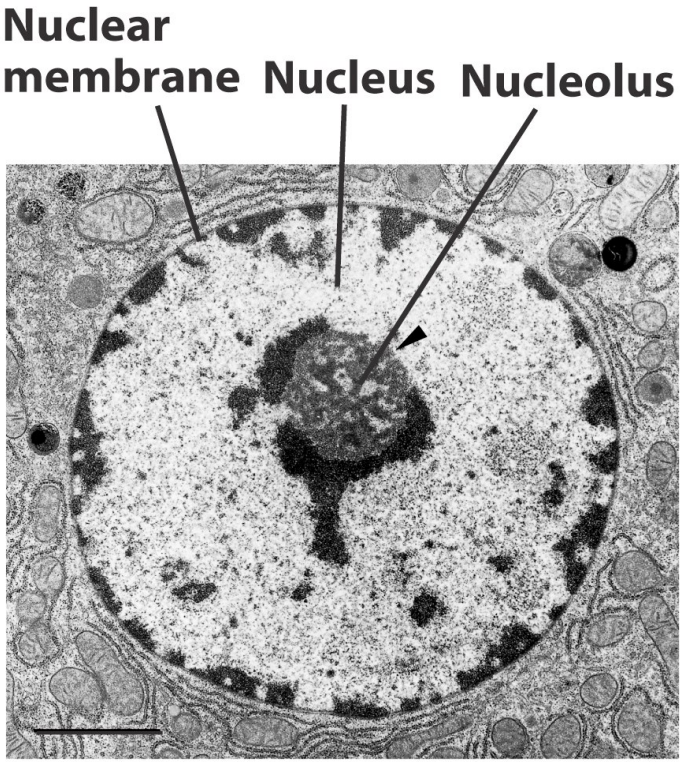
*http://library.thinkquest.org/12413/structures.html*

# Nucleolus-found in the nucleus

Most cells have 2 or more

Directs synthesis of RNA

Forms ribosomes




## Endoplasmic Reticulum

Helps move substances within cells

Network of interconnected membranes

Two types

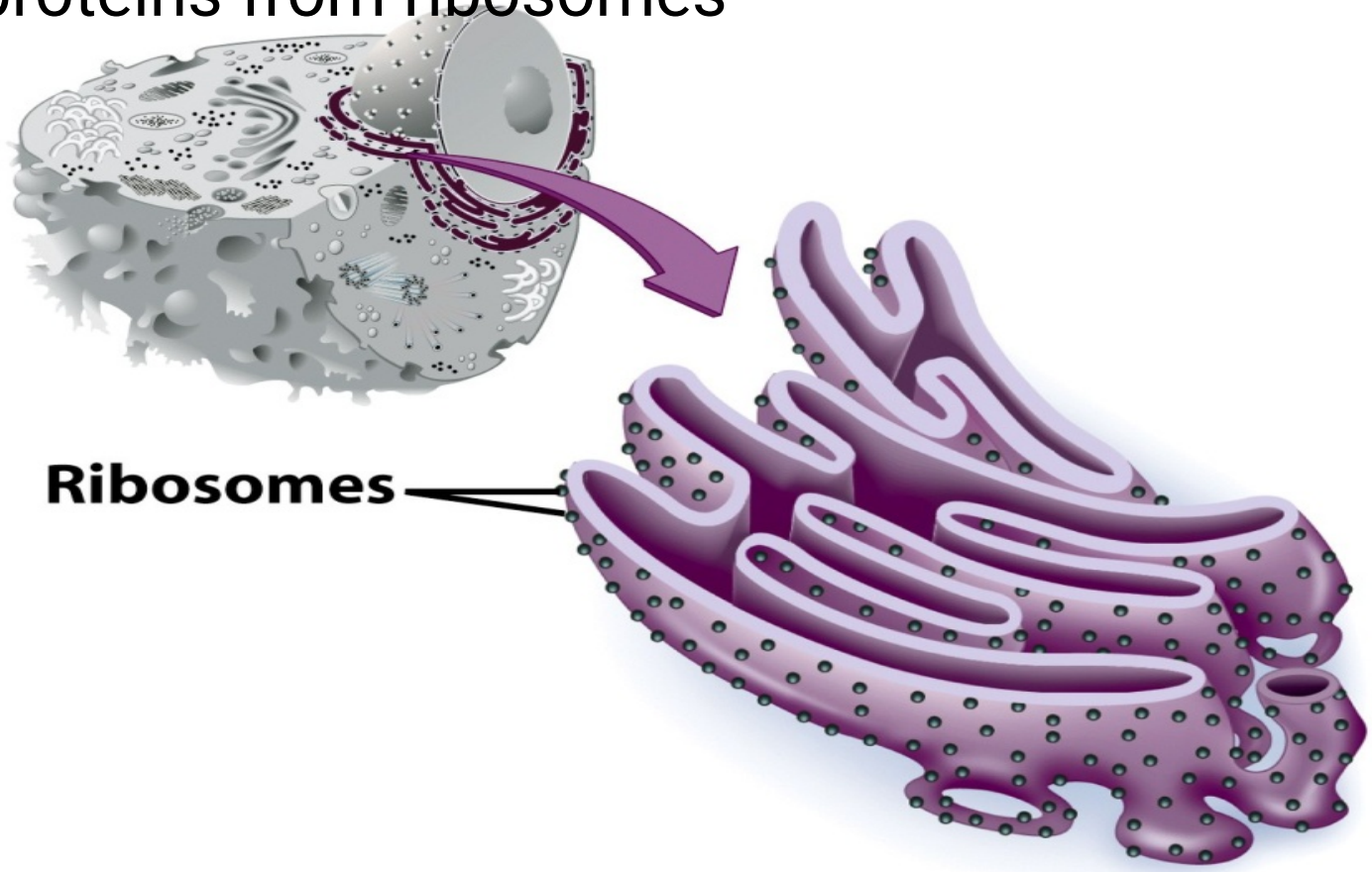
- Rough endoplasmic reticulum
- Smooth endoplasmic reticulum

# Rough Endoplasmic Reticulum

Ribosomes attached to surface

- Manufacture protiens
- Not all ribosomes attached to rough ER

May modify proteins from ribosomes

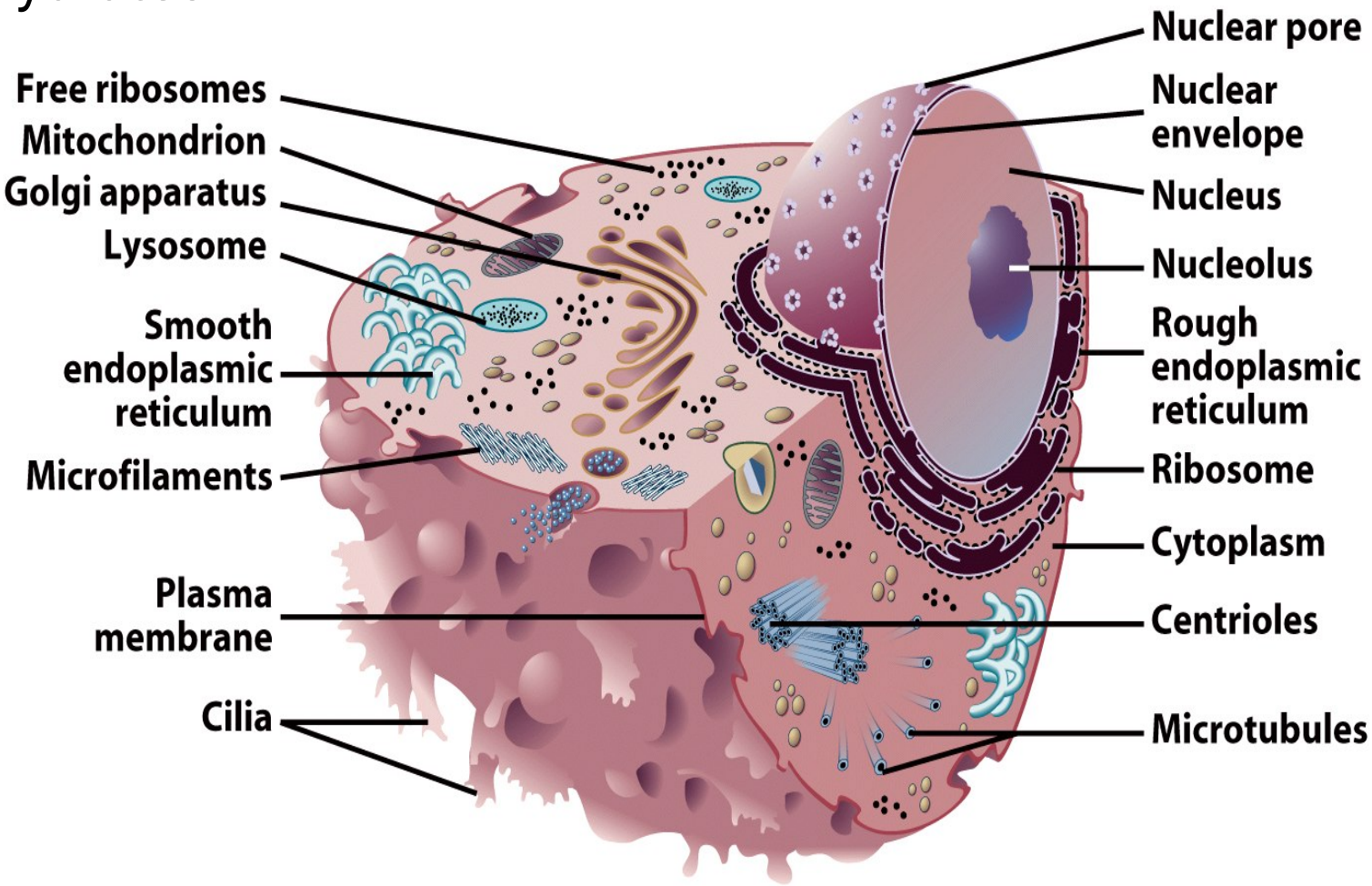


# Smooth Endoplasmic Reticulum

No attached ribosomes

Has enzymes that help build molecules

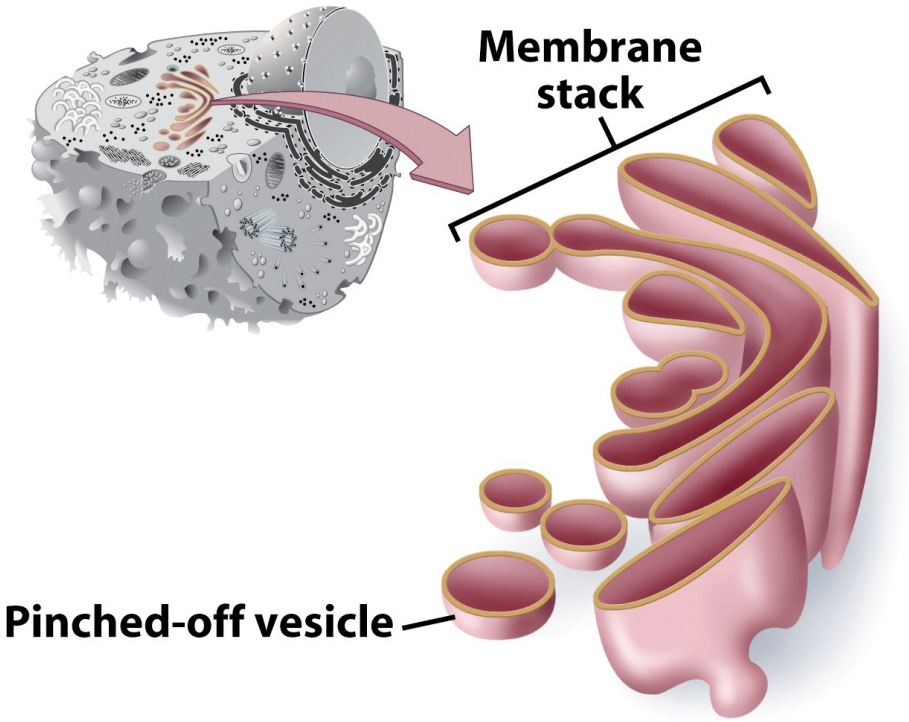
- Carbohydrates
- Lipids



# Golgi Apparatus

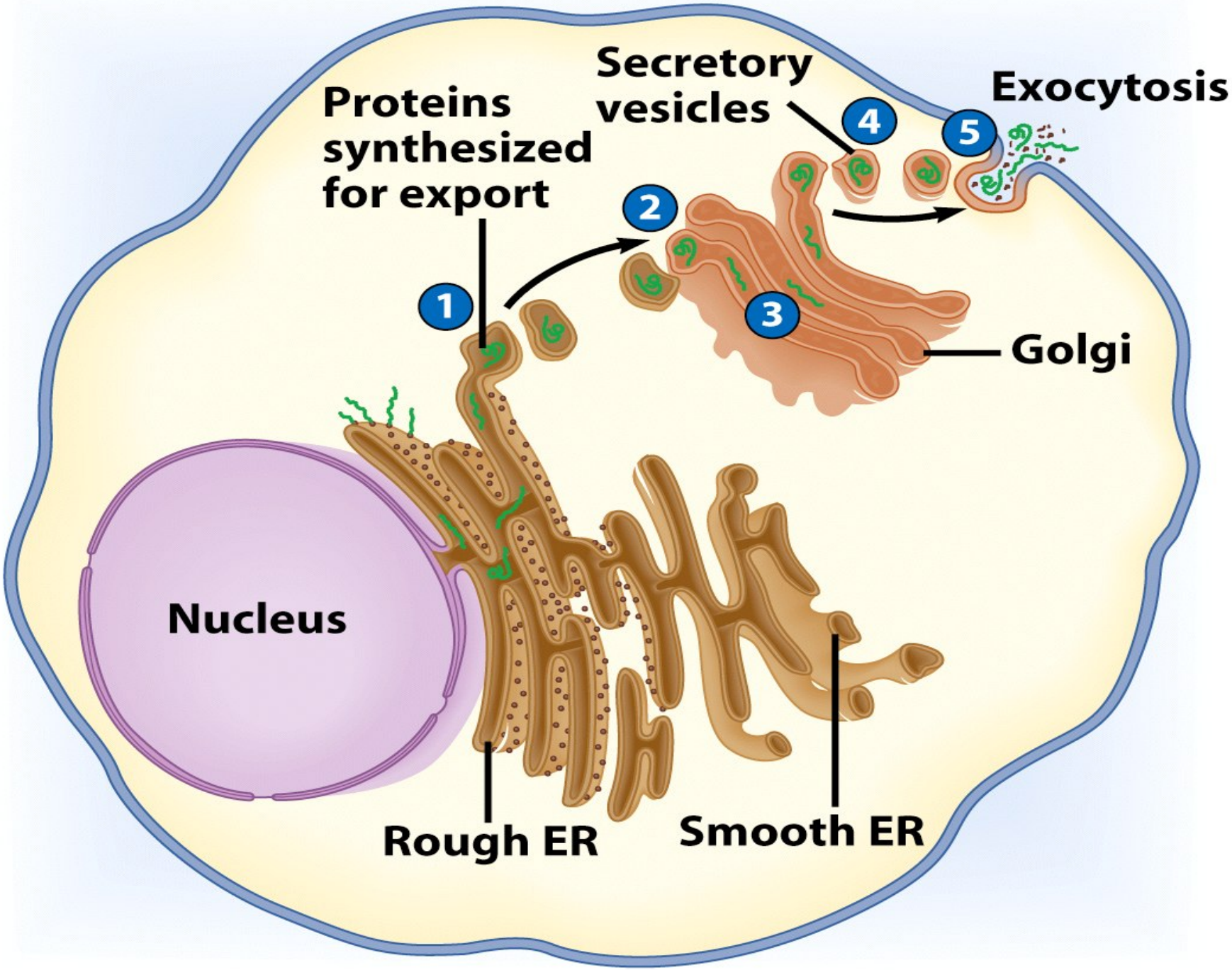
Involved in synthesis of plant cell wall

Packaging & shipping station of cell



# Golgi Apparatus Function

1. Molecules come in vesicles
2. Vesicles fuse with Golgi membrane
3. Molecules may be modified by Golgi
4. Molecules pinched-off in separate vesicle
5. Vesicle leaves Golgi apparatus
6. Vesicles may combine with plasma membrane to secrete contents


Proteins synthesized for export
Secretory vesicles
Exocytosis
1
2
3
4
5
Golgi
Nucleus
Rough ER
Smooth ER

## Lysosomes

Contain digestive enzymes

Functions

- Aid in cell renewal
- Break down old cell parts
- Digests invaders

## Vacuoles

- Membrane bound storage sacs
- More common in plants than animals
- Contents
  - Water
  - Food
  - wastes

# Bacteria-Like Organelles

Release & store energy

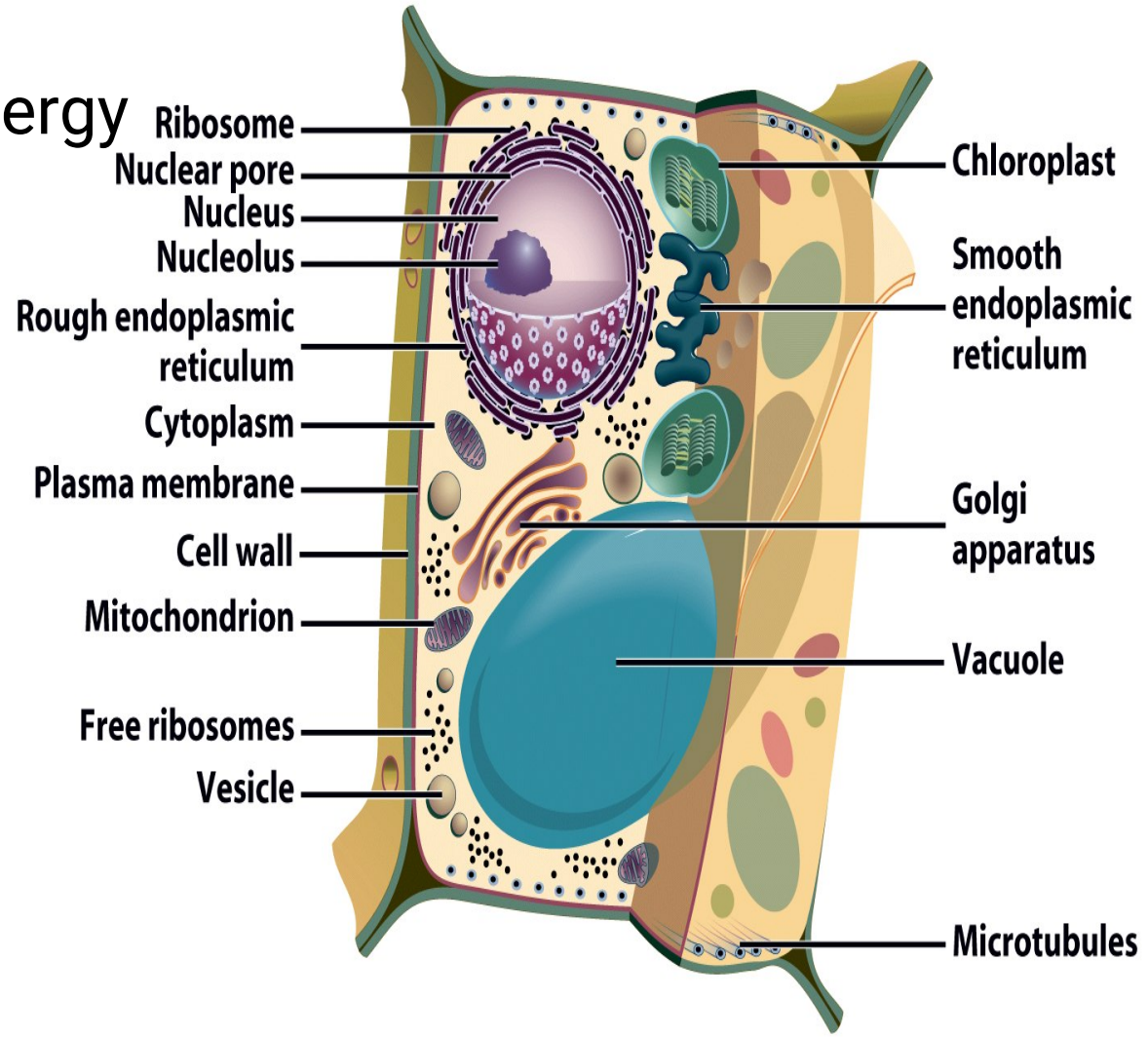
Types

Mitochondria

(release energy)

Chloroplasts

(store energy)



# Mitochondria

Have their own DNA

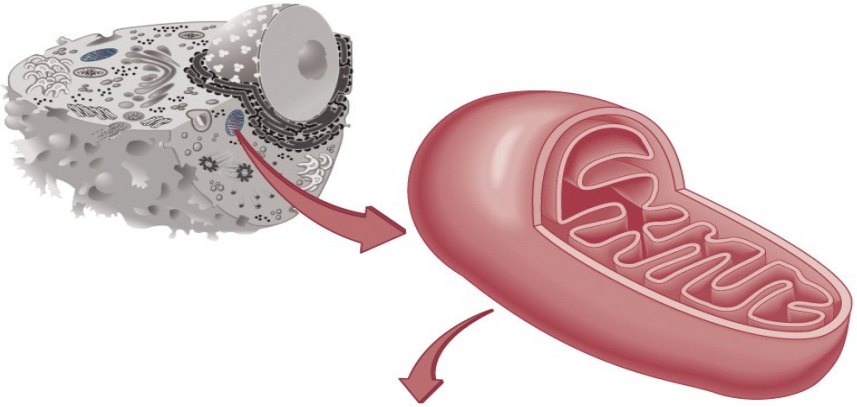
Bound by double membrane

Break down fuel molecules (cellular respiration)

- Glucose
- Fatty acids

Release energy

- ATP



# Chloroplasts

Derived form photosynthetic bacteria

Solar energy capturing organelle

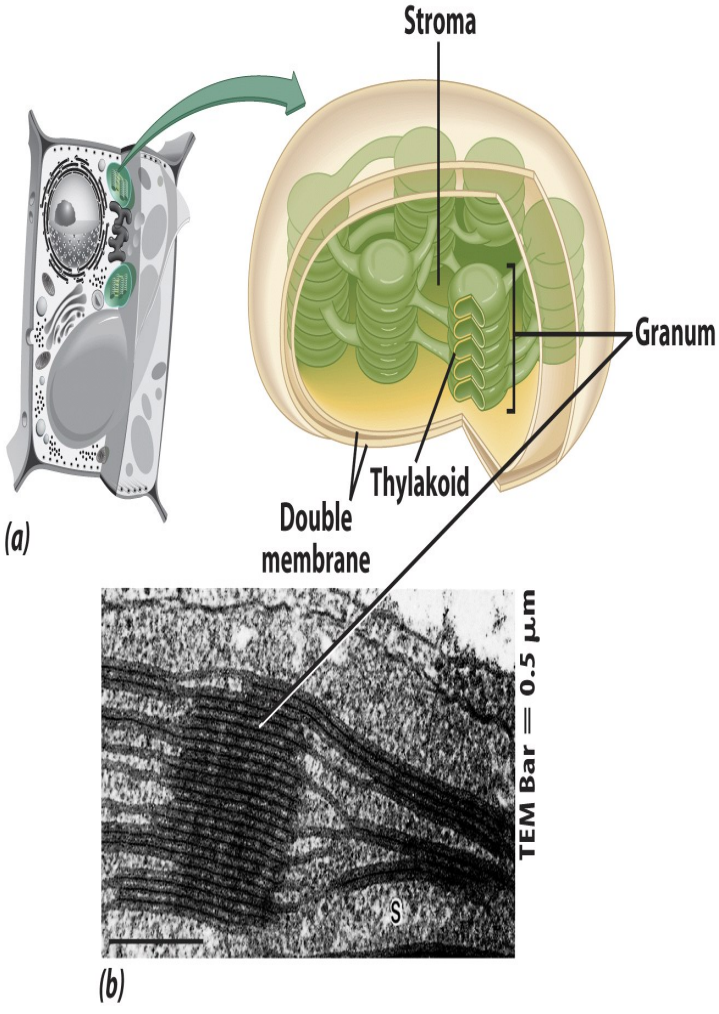
Takes place in the chloroplast

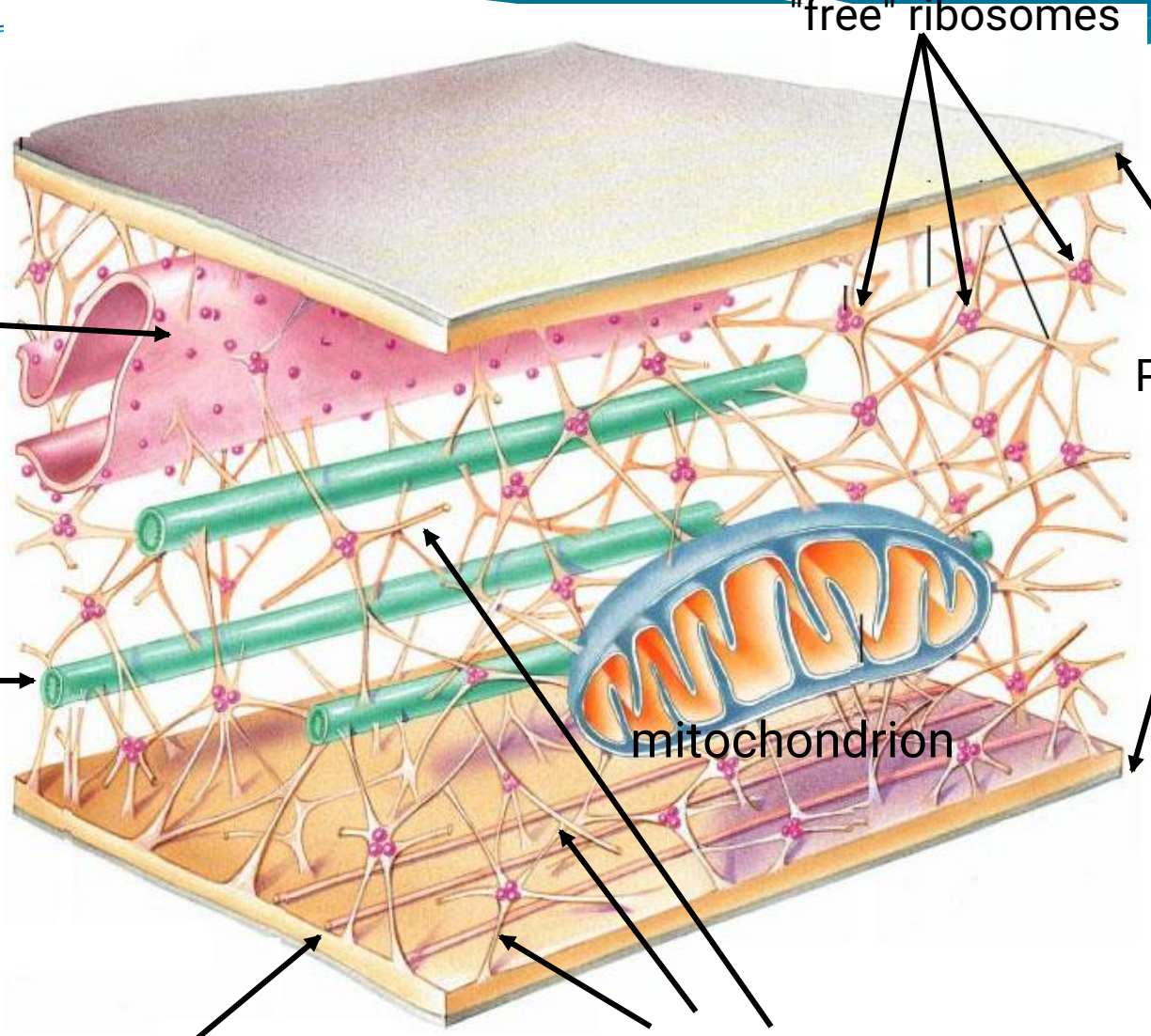
Makes cellular food – glucose

photosynthesis

Takes place in the chloroplast

Makes cellular food – glucose




"free" ribosomes
ER
Plasma membra
microtubule
mitochondrion
microfilament
Intermediate filaments

# Review of Eukaryotic Cells

**TABLE 5.1 Eukaryotic Cell Structures and Their Functions**

| Structure | Description | Function |
|---|---|---|
| **Exterior Structures** | | |
| Cell wall | Outer layer of cellulose or chitin, or absent | Protection, support |
| Plasma membrane | Lipid bilayer in which proteins are embedded | Regulation of what passes in and out of cell, cell-to-cell recognition |
| Flagella (cilia) | Cellular extensions with 9 + 2 arrangement of pairs of microtubules | Motility or moving fluids over surfaces |

# Review of Eukaryotic Cells

**TABLE 5.1 Eukaryotic Cell Structures and Their Functions**

| Structure | Description | Function |
|---|---|---|
| **Interior Structures and Organelles** | | |
| Endoplasmic reticulum (ER) | Network of internal membranes | Formation of compartments and vesicles; modification and transport of proteins; synthesis of carbohydrates and lipids |
| Ribosomes | Small, complex assemblies of protein and RNA, often bound to ER | Sites of protein synthesis |
| Nucleus | Spherical structure bounded by a double membrane, site of chromosomes | Control center of cell |
| Chromosomes | Long threads of DNA associated with protein | Sites of hereditary information |
| Nucleolus | Site within nucleus of rRNA synthesis | Synthesis and assembly of ribosomes |
| Golgi apparatus | Stacks of flattened vesicles | Packaging of proteins for export from cell |
| Lysosomes | Membranous sacs containing digestive enzymes found in animal cells | Digestion of various molecules |
| Cytoskeleton | Network of protein filaments, fibers, and tubules | Structural support, cell movement |
| Mitochondria | Bacteria like elements with inner membrane highly folded | "Power plant" of the cell |
| Chloroplasts | Bacterialike elements with inner membrane forming sacs containing chlorophyll, found in plant cells and algae | Site of photosynthesis |

# Molecule Movement & Cells

Passive Transport

Active Transport

Endocytosis-(phagocytosis & pinocytosis)

Exocytosis

<u>Passive Transport</u>

i. No energy required

ii. Move due to gradient

differences in concentration, pressure, charge

iii. Move to equalize gradient

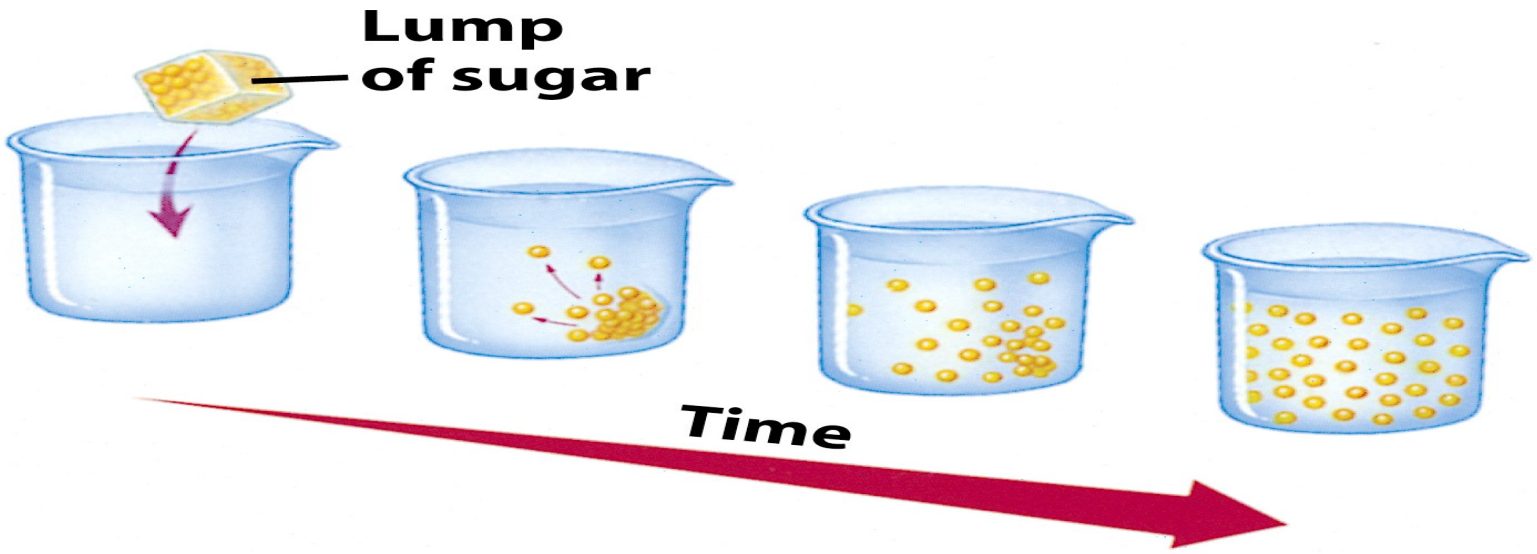
High moves toward low

# Types of Passive Transport

1. Diffusion
2. Osmosis
3. Facilitated diffusion

Diffusion

- Molecules move to equalize concentration



Special form of diffusion

Fluid flows from lower solute concentration

Often involves movement of water

Into cell

Out of cell

## Solution Differences & Cells

solvent + solute = solution

Hypotonic

Solutes in cell more than outside

Outside solvent will flow into cell

Isotonic

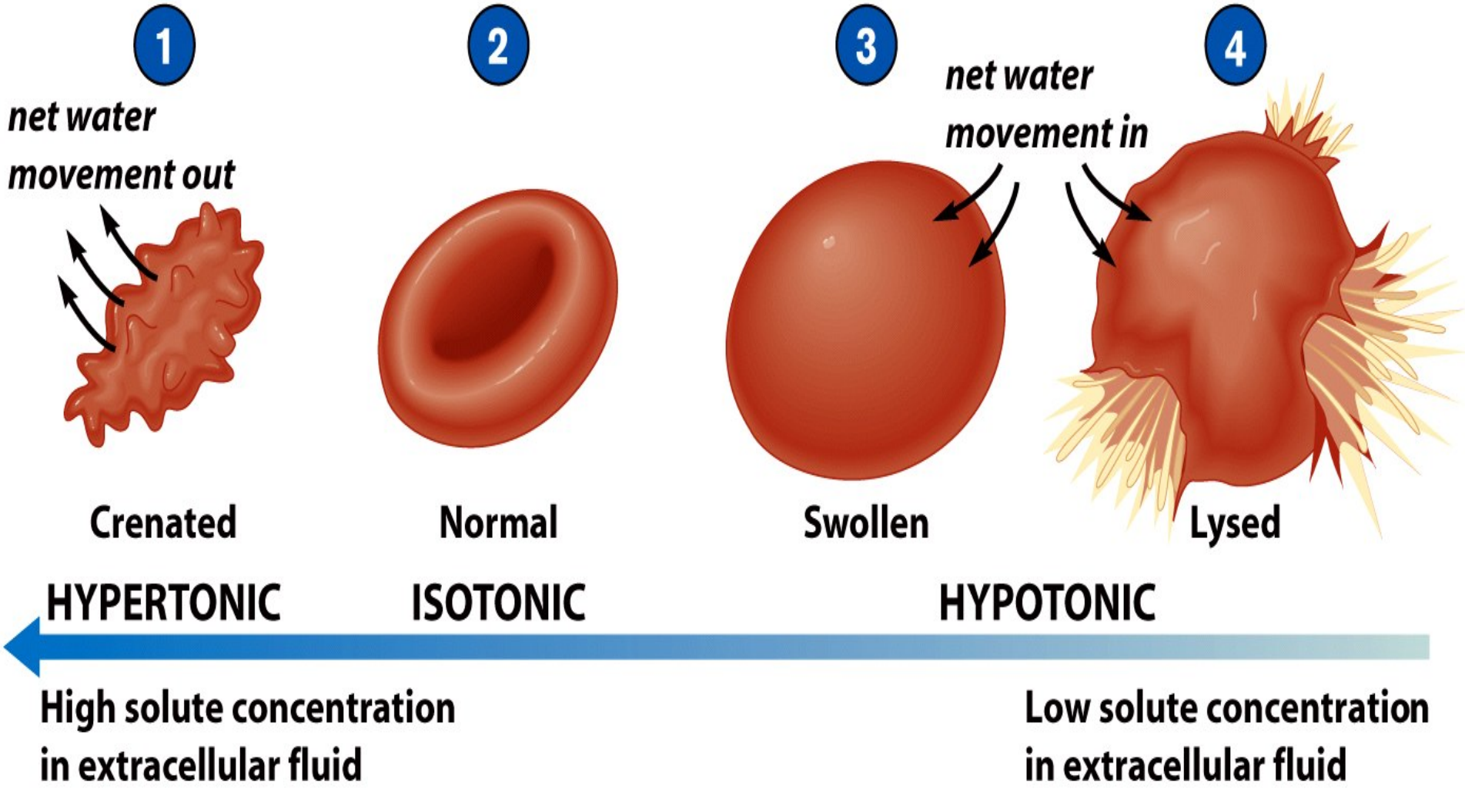
-Solutes equal inside & out of cell

Hypertonic

-Solutes greater outside cell. Fluid will flow out of cell

# Types of Passive Transport

1. Diffusion
2. Osmosis
3. Facilitated diffusion

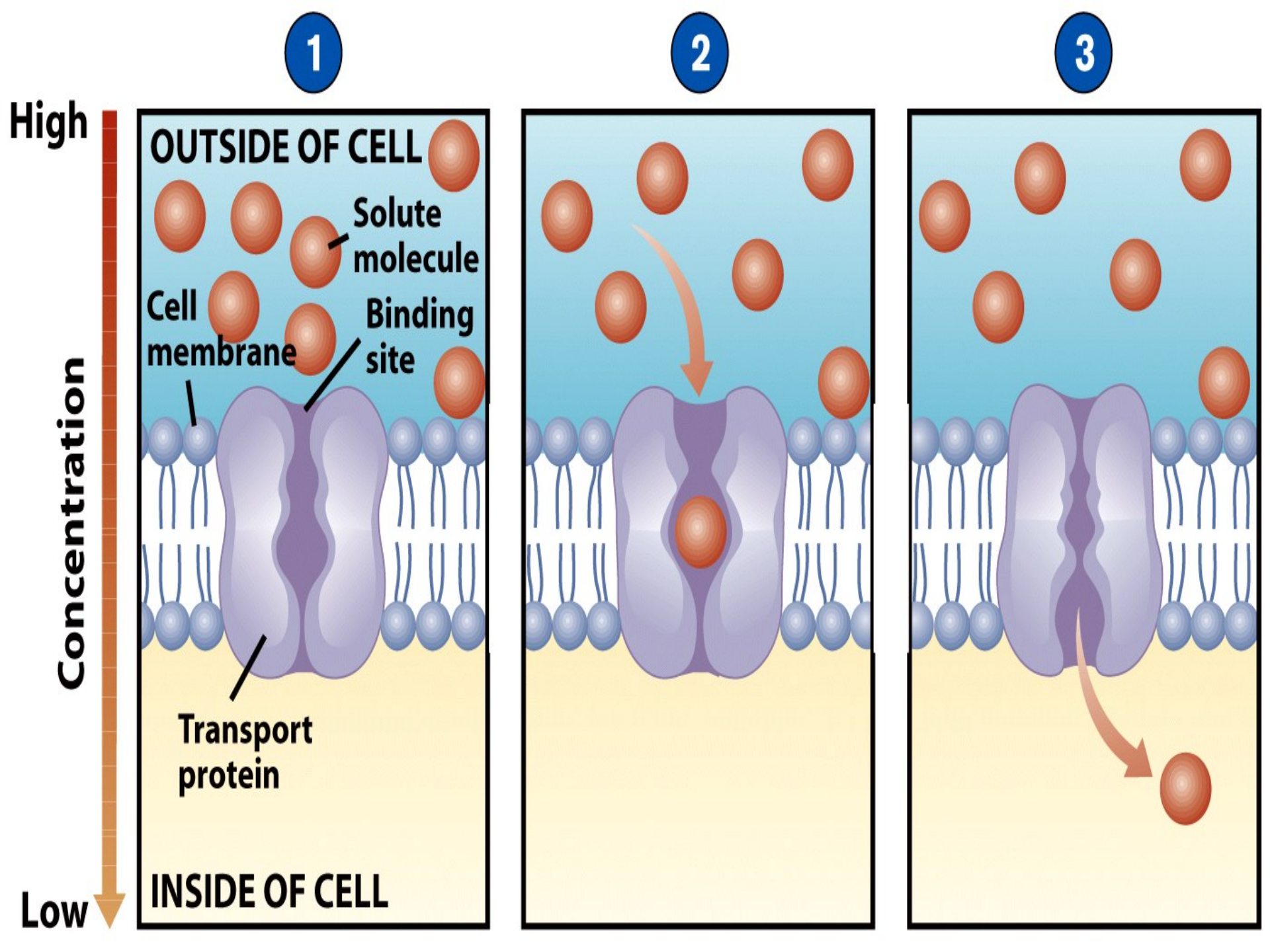


# Facilitated Diffusion

- Differentially permeable membrane
- Channels (are specific) help molecule or ions enter or leave the cell
- Channels usually are transport proteins (aquaporins facilitate the movement of water)
- No energy is used

**Process of Facilitated Transport**

- Protein binds with molecule
- Shape of protein changes
- Molecule moves across membrane (see diag. below)


1
2
3
High
Concentration
Low
OUTSIDE OF CELL
Solute molecule
Cell membrane
Binding site
Transport protein
INSIDE OF CELL

**Active transport** - movement of a substance from a lower concentration to a higher concentration using a carrier and energy

**Endocytosis** - brings substances into the cells

:**solutes moving against concentration gradient**

-Uses carrier proteins ,can be driven by ATP use or via energy stored in ionic concentration

Types :

Primary active transport

Secondary active transport

1. Endocytosis
2. Exocytosis
3. Transcytosis

# Primary active transport

uses ATP and transporter proteins sodium potassium pump

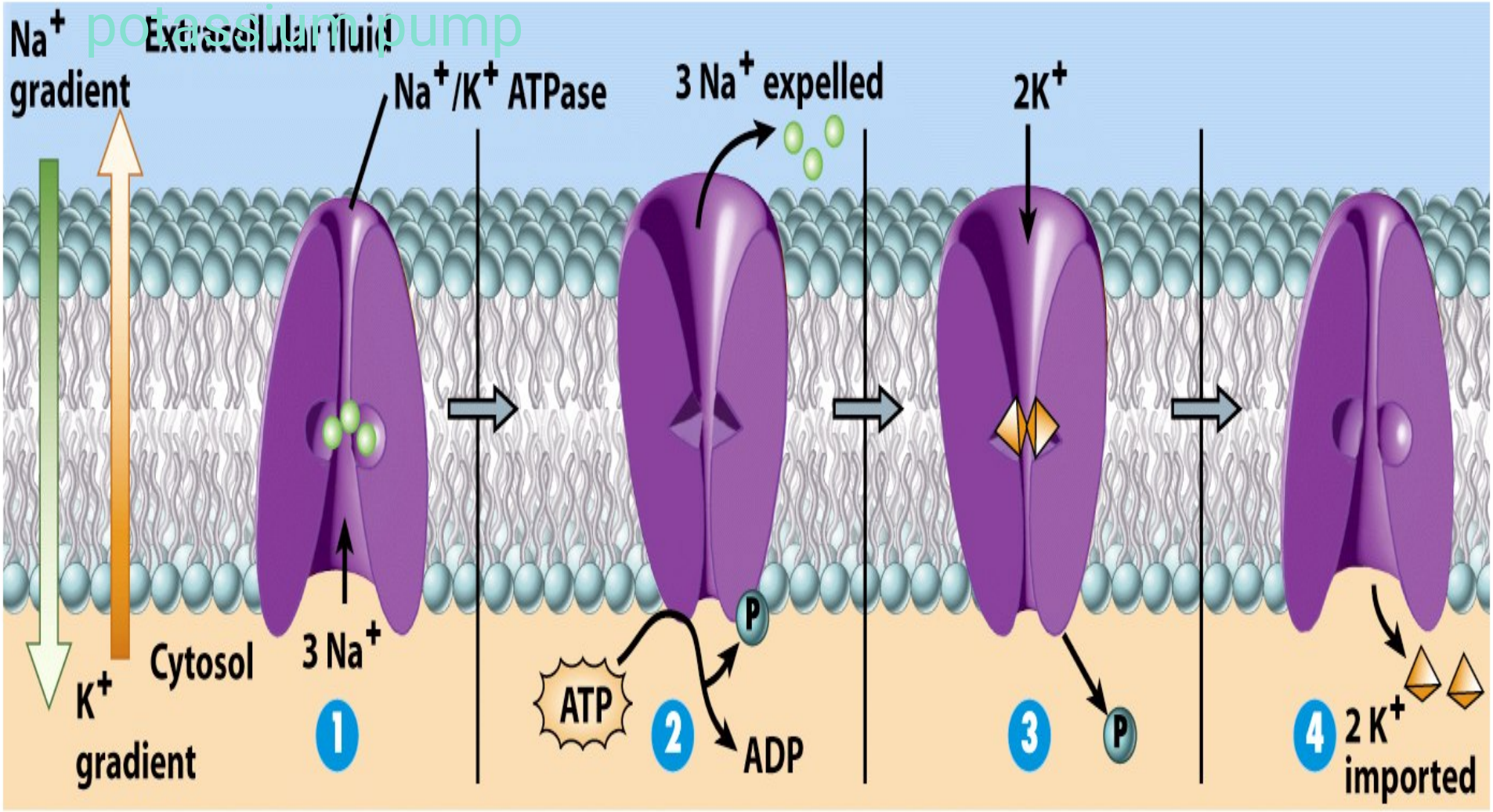


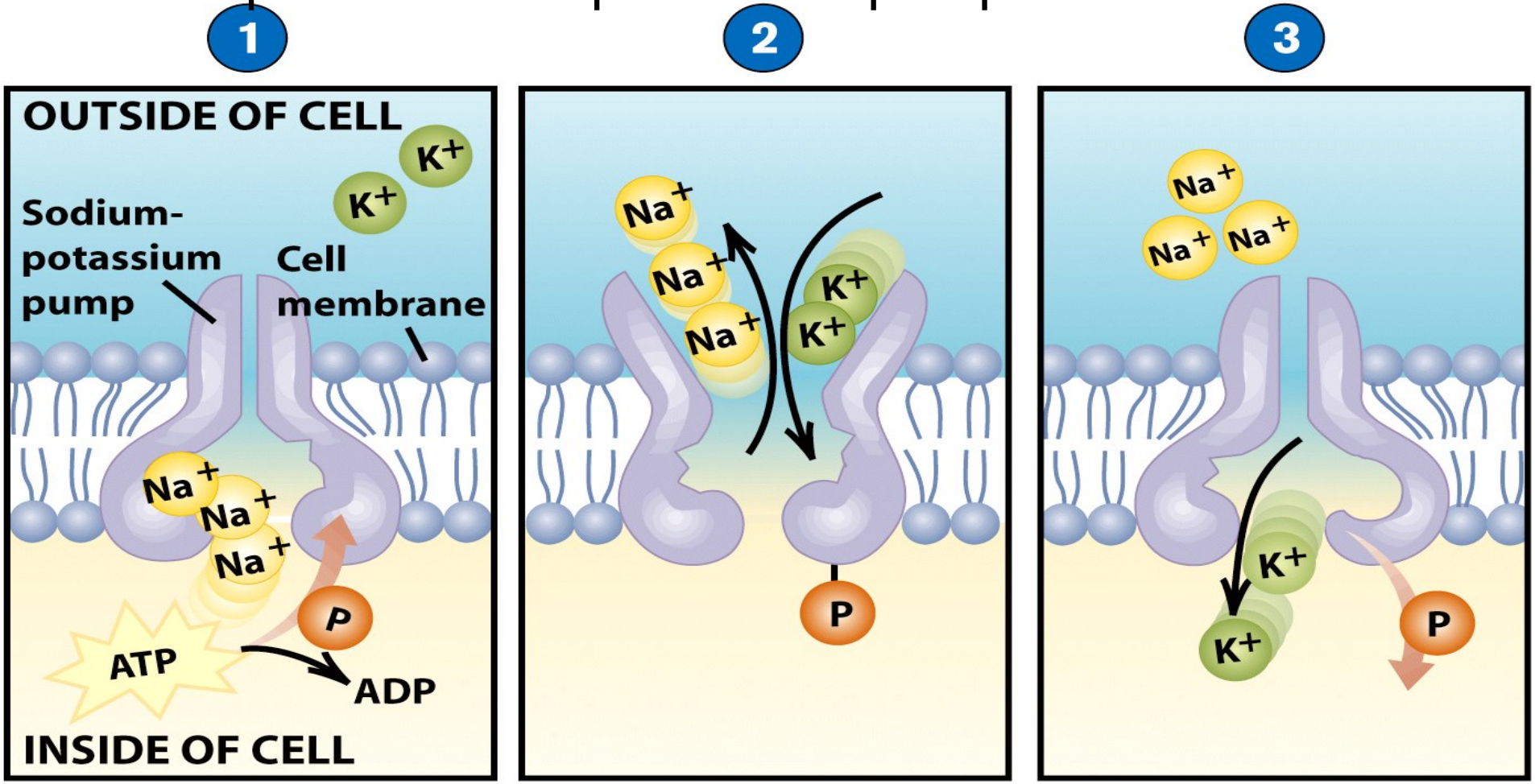

Figure 3-8 Anatomy and Physiology: From Science to Life

# Active Transport

Molecular movement

Requires energy (against gradient)

Example is sodium-potassium pump



# Endocytosis

Movement of large material

Particles

Organisms

Large molecules

Movement is into cells

Types of endocytosis

bulk-phase (nonspecific)

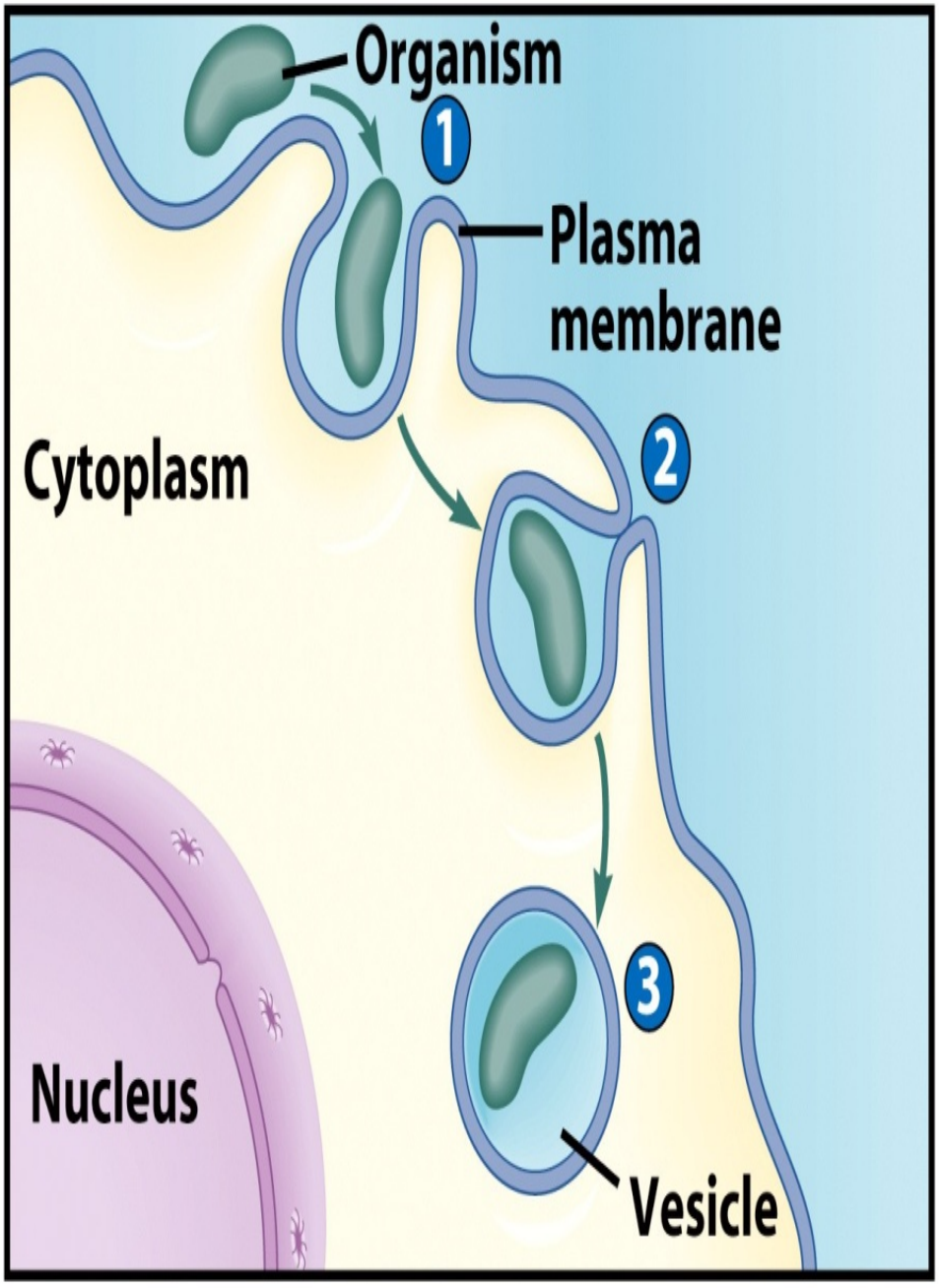
receptor-mediated (specific)

**Process of Endocytosis**

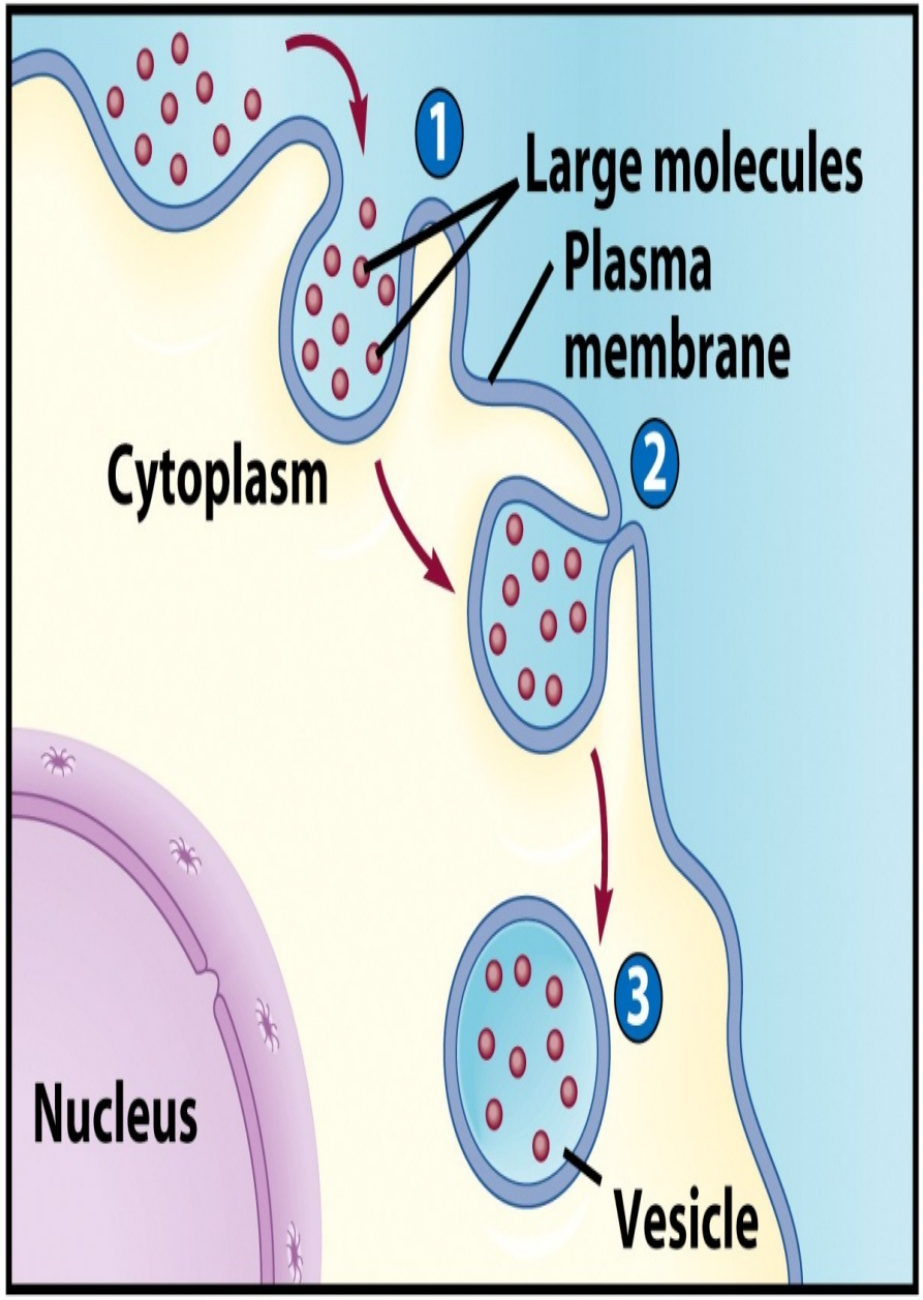
Plasma membrane surrounds material

Edges of membrane meet

Membranes fuse to form vesicle **s**




PHAGOCYTOSIS




PINOCYTOSIS

# Endocytosis

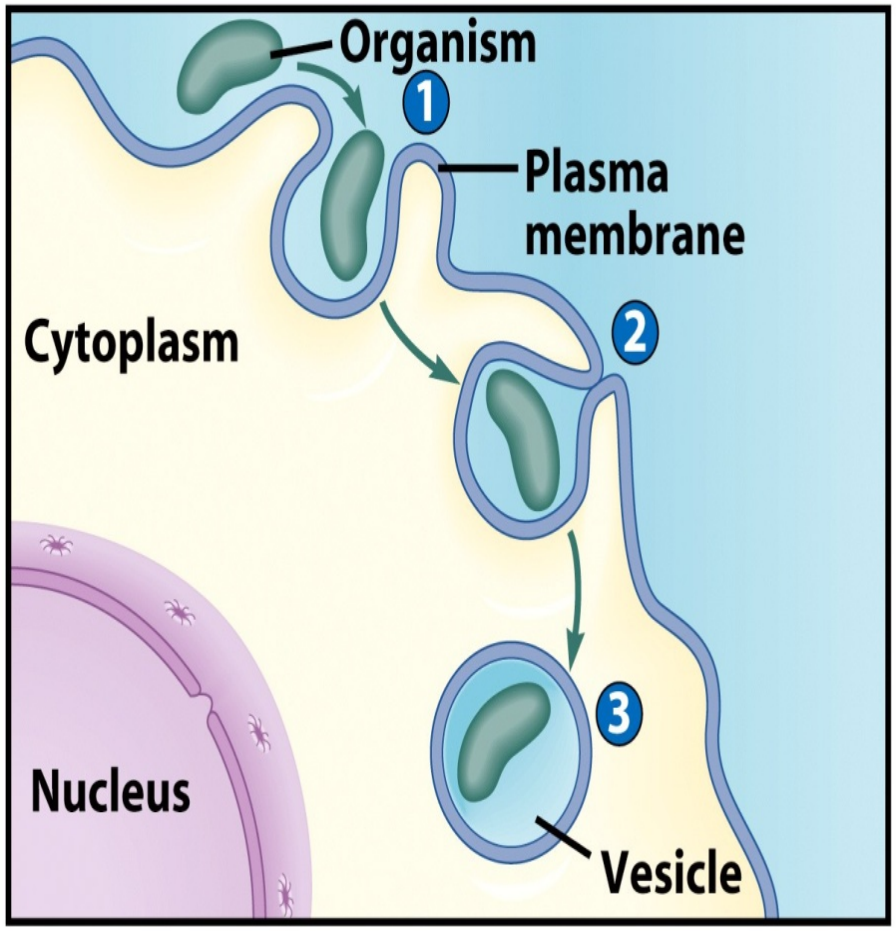
- Movement of large material
  - Particles
  - Organisms
  - Large molecules
- Movement is into cells
- Types of endocytosis
  - bulk-phase (nonspecific)
  - receptor-mediated (specific)

# Process of Endocytosis

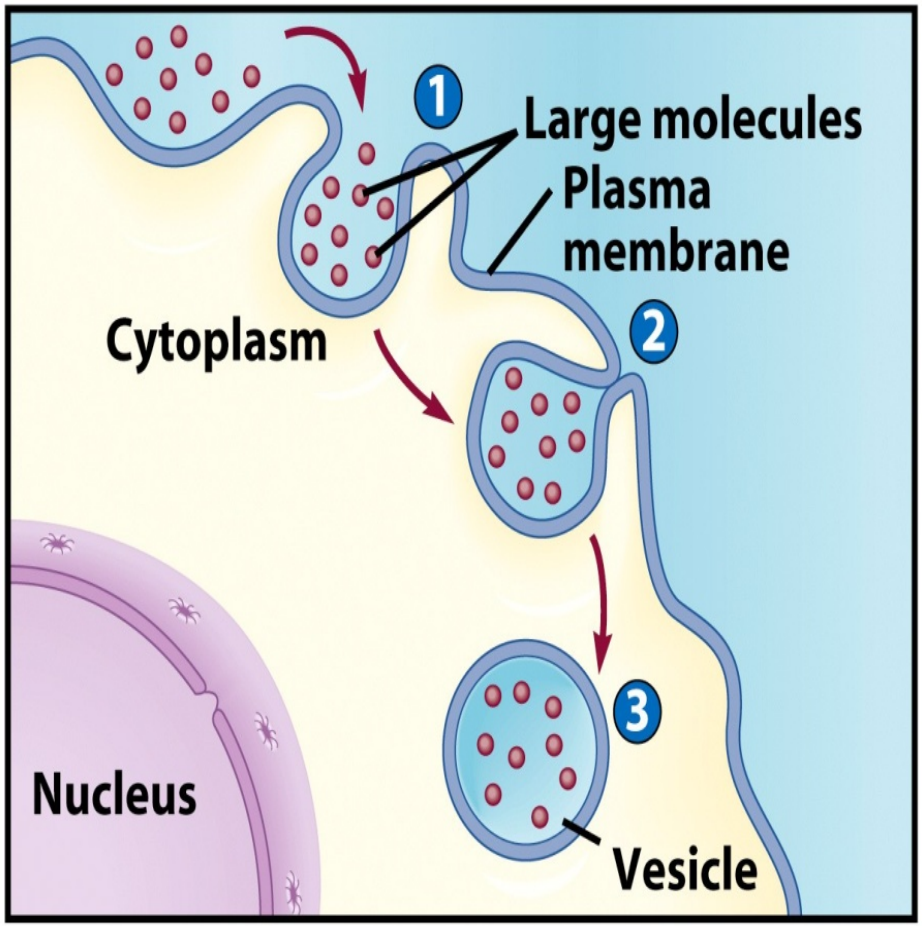
Plasma membrane surrounds material

Edges of membrane meet

Membranes fuse to form vesicle




PHAGOCYTOSIS

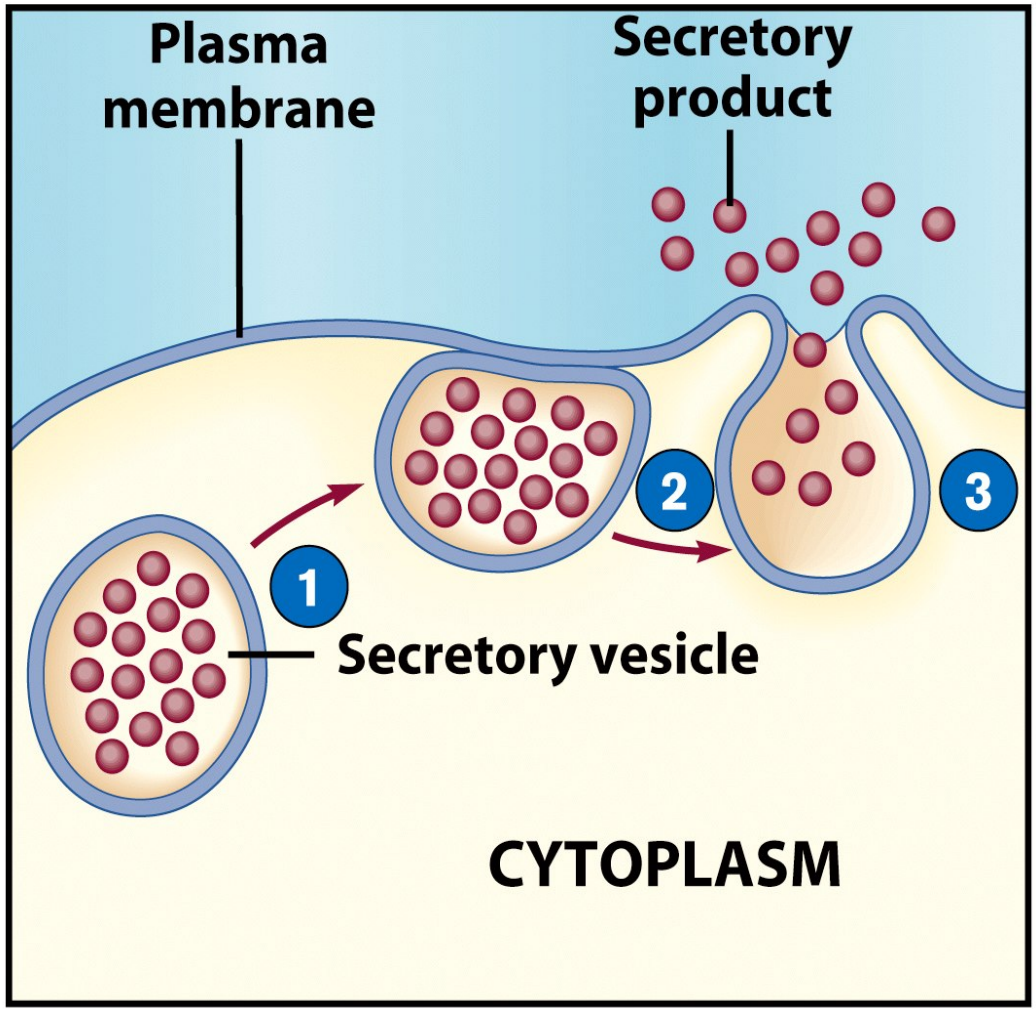


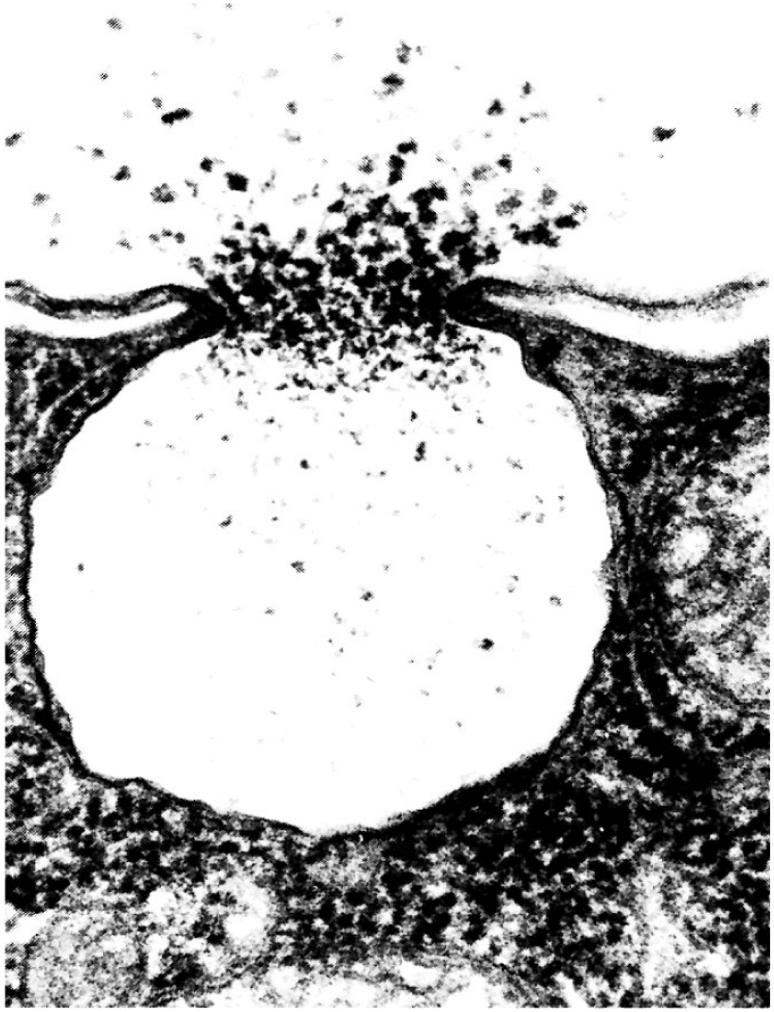

PINOCYTOSIS

# Exocytosis

Reverse of endocytosis

Cell discharges material

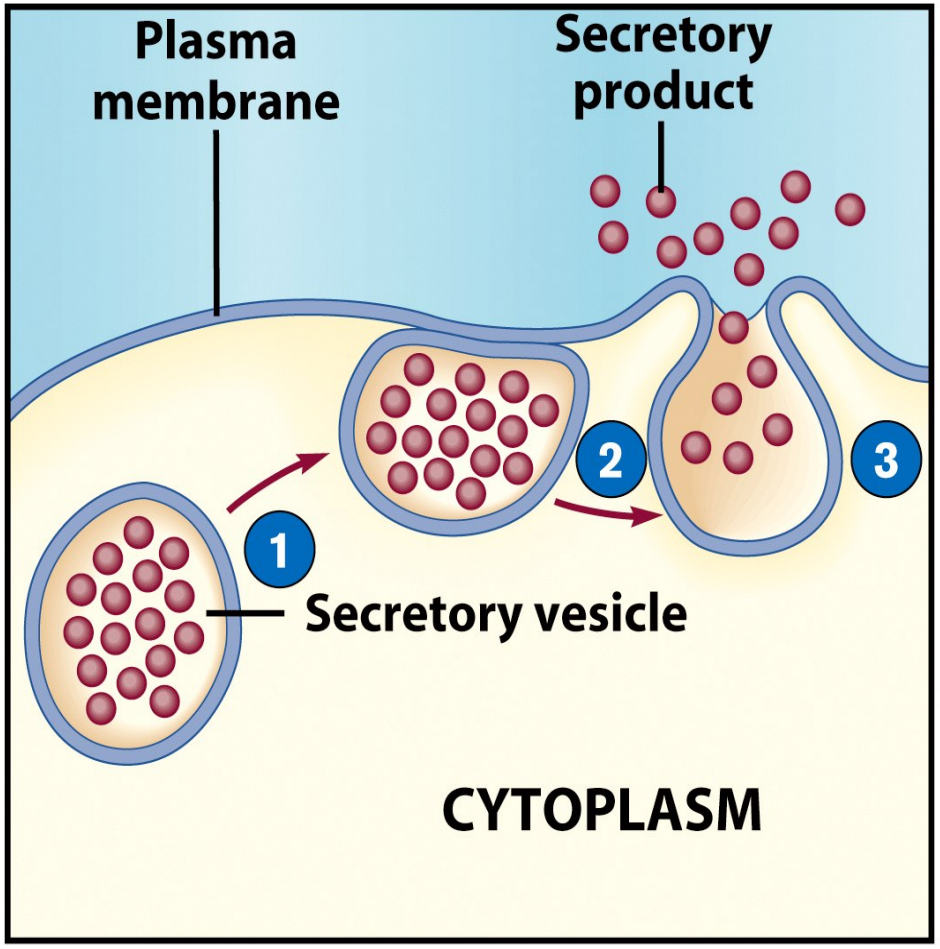


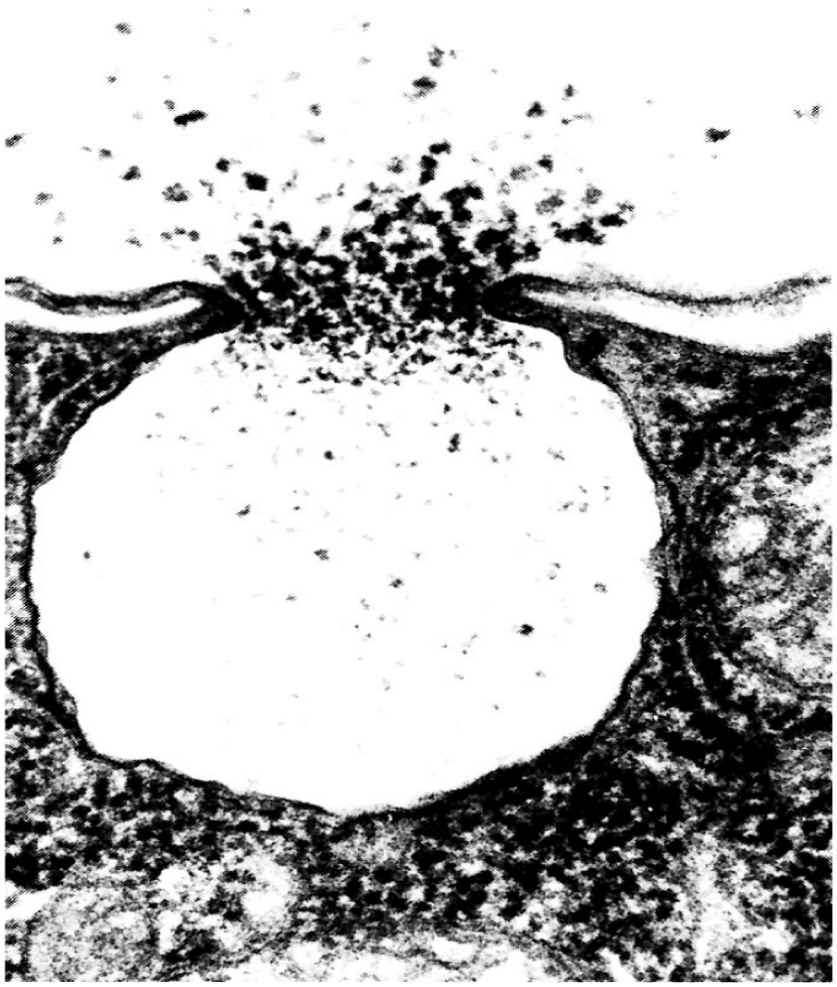



# Exocytosis

Vesicle moves to cell surface

Membrane of vesicle fuses



END

# THANK YOU

# EMBRYOLOGY

- Embryology simply means the study of embryos.
- It generally refers to prenatal development of embryos and developmental anatomy is the field of embryology concerned with the changes that cells, tissues , organs and the body as whole undergo from a germ cell of each parent to the resulting adult.
- Pre-natal development is more rapid than postnatal development.

# Why study embryology?

Interests in human development before birth is widespread, largely because of curiosity about our beginnings and the desire to improve quality of life.

Human development is a continuous process that begins when an oocyte (ovum) from a female is fertilized by a sperm (Spermatozoon) from a male. Cell division, cell migration, differentiation growth and cell rearrangement transform the fertilized oocyte a highly specialized potent cell a zygote into a multicellular human being. Although most development changes occur during the embryonic and fetal periods , important changes occur during later periods of development - infancy childhood adolescence and early childhood.

Development does not stop at birth important changes in addition to growth occur after birth e.g. development of teeth and female breasts. The brain triples in weight between birth and 16 years most development changes are complete by the age of 25 years.

# Embryological Terminologies

- The following terms are commonly used in discussions of the developing humans.
- Most terms have Latin (L.) Greek (Gr.) origins.
- Understanding the origin of embryological terms adds clarity and often serves as a memory key.
- For example the word Zygote is derived from a Greek word Zygotos meaning yoked or joined , which indicates that the sperm and oocyte unite to form a new cell the Zygote.

Oocyte: (Ovum, egg) the female germ or sex cell produced in the ovaries is called a secondary oocyte or mature oocyte.

Sperm: (Gr. Sperma, seed)  (Latin- Spermatozoon). The sperm or spermatozoon , refers to the male germ cell produced in the testes (testicles). Numerous sperms (Spermatozoa) are expelled from the male urethra during ejaculation.

Zygote:- This cell result s from the union of an oocyte and a sperm during fertilization . A zygote is the beginning of a new human being (i.e. an embryo).

## 4. Fertilization age:

- It is difficult to determine exactly when fertilization (conception) occurs because the process cannot be observed in vivo (within the living body).
- Physicians calculate the age of the embryo or fetus from the presumed first day of the last normal menstrual period (LNMP). This is the gestational age, which is about two weeks longer than the fertilization age because, the oocyte is not fertilized until about two weeks after the proceeding menstruation consequently when a physician states the age of an embryo or fetus, two weeks must be deducted to determine the actual or fertilization age of the developing human

**5. Cleavage:**

This is the series of mitotic cell division of the zygote that results is the formation of the early embryonic cells- blastomeres. The size of the cleaving zygote remains unchanged because at each succeeding cleavage division, the blastomeres become smaller.

**6. Morula-** (L. Morus Mulbery): This solid mass of about 12-32 blastomeres is formed by cleavage of a zygote. The blastomeres change their shape and fightly align themselves against each other to form a compact ball of cells this phenomenon- compaction is probably mediated by cell surface adhesion glycoproteins . The morula was given this name because of its resemblance to the fruit a mulberry or blackberry bush. The morula stage occurs 3-4 days after fertilization, just as the early embryo enters the uterus.

**7.Blastocyst:** (Gr. Blastos, germ +kystis)

After the morula enters the uterus from the uterine tube – fallopian tube - a fluid filled cavity – the blastocystic cavity –develops inside it . This change converts the morula into a blatocyst. Its centrally located cells- the inner cell mass or embryoblast are the primodium or beginning of the embryo.

**8. Implantation:** The process during which the blastocyst attaches to the endometrium – mucous memberane or lining of the uterus- and subsequently embeds in it. The pre-implantation period of embryonic development is the time between fertilization and the beginning of implantation takes 6days.

**9. Gastrula-** This is the period of transformation a blastocyst into a three layered or trilaminar embryonic disc. This takes place in the 3 rd week . The three germ layers of the gastrula – Ectoderm, mesoderm and Endoderm subsequently differentiate into the tissues and organs of the embryo e.g. Muscular tissue and stomach .

**10. Neurula-** (Gr. Neuron, nerve- The early embryo during the third and fourth weeks when the neural tube is developing from the neural plate. It is the 1 st appearance of the nervous system , and the next stage after the gastrula.

**11. Conceptus -** (derivatives of Zygote). The embryo and its associated membranes ( the products of conception). The conceptus includes all structures that develop from the zygote, both embryonic and extra-embrayonic hence it includes the embryo as well as the embryonic part of the placenta and its associated memberanes - Amnions

-Chorionic sac (gestational sac)

- and yolk sacs

**12. Fetus:** (unborn off spring ). After the embryonic period 8weeks the developing human is called a fetus. During the fetal period -9th week to birth differentiation and growth of the tissues and organs formed during the embryonic period occur.

Although developmental changes are not so dramatic as those happening during the embryonic periods they are very important because they make it possible for the tissues and organs to function.

The rate of body growth is remarkable, especially during the 3rd and 4th months, and weight gain is terminal during the terminal months.

## 13. Primodium-

## (L. Primus – first to begin)

- The beginning or first indication of organ or structure.
- The term enlarge or rudiment have similar meanings. The premodium of the upper limits appears as a bud on day 26.

# Stages of Development

- Early embryonic development is described in stages because of the variables period it takes for embryos to develop certain morphological characteristics.

# Stage 1 of development

- Begins at fertilization and embryonic development ends at stage 23 which occurs on day 56 . The fetal period begins on day 57 and ends when the fetus is completely outside the mother. The stages of embryonic development
- Can be assessed by an ultrasound

# **Abortions** (L. Aboriri, to miscarry)

- A premature stoppage of development and expulsion of a conceptus from the uterus or expulsion of an embryo or fetus before it is viable - capable of living outside the uterus.

***There are different types of abortions:-***

**Threatened abortion**: Bleeding with the possibility of abortion)

**Accidental abortion**: Occurs because of an accident e.g. fall, trauma etc.

**Spontaneous abortion**: Is the one that occur naturally and is most common during 3rd wk after fertilization.

**4. Habitual abortion:** spontaneous expulsive of a dead or non-viable embryo on fetus in three or more consecutive pregnancies.

**5. Induced abortion:** Is a birth that is induced before 20 weeks (i.e. before the fetus is viable) . This type of abortion refers to the expulsion of an embryo or fetus that is brought on intentionally by drugs or mechanical means e.g. by vacuum curettage-removal of conceptus by a hollow curette introduced into the uterus through which sunction is applied.

6. **Complete abortion:** This is which all products of conception are expelled from the uterus.

7. **Criminal abortion:** Is one that is produced illegally.

8. **Legally induced:** (elective, justifiable or therapeutic abortions are usually produced by drugs curettage.

These abortions are usually induced because of the mothers poor health (physical or mental) or to prevent the birth of a severely malformed child e.g. one without most of its brain.

**9. Missed abortion:** Is the retention of a conceptus in the uterus after death of the embryo or fetus.

**10. A miscarriage:** Is the spontaneous abortion of the fetus and its membranes before the middle of the 2nd trimester- about 135 days).

**11. An abortus:** Is the product of an abortion . i.e. the embryo , fetus and its membranes.

# Trimester

- A period of three calendar months during a pregnancy. Obstetricians commonly divide the 9 months of gestation into three trimesters. The most critical stages of development occur during the first trimester (13wks) when embryonic and early fetal development is occurring.

# Congenital Anomalies or Birth defects

- Abnormalities of development that are present at birth or born with e.g. a cleft lip or palate. In some cases the anomalies are not detected until childhood or even adulthood e.g. three kidneys instead of two.

# Postnatal Period

- Changes occurring after birth

# Infancy

- Infancy refers to the earliest period of extrauterine life roughly the first year after birth. An infant aged one month or less is called a newborn or neonate.
- Transition from intrauterine to extrauterine existence requires many critical changes especially in the cardiovascular and respiratory systems. If a neonate survives the first crucial hours after.

# Teratology

- In Greek word means monster . It is the divisions of embryology and pathology that deals with abnormal development (or birth defects). This branch of embryology is concerned with various genetic and environmental factors that disturb normal development and produce birth defects.

# Significance of Embryology

Bridges the gap between prenatal development and obstetrics , perinatal medicine, peadiatrics and clinical anatomy.

Develops knowledge concerning the beginning of human life and the changes occurring during prenatal development.

It is of practical value in helping to understand the causes of variations in human structure.

Explains how normal and abnormal relations develop.

NB:

- Knowledge that physicians have of normal development and the causes of anomalies is necessary for giving embryo and fetus the greatest possible chance of developing normally.
- Much of the modern practice of obstetrics involves applied embryology.
- Embryological topics of special interest to obstetricians are :-

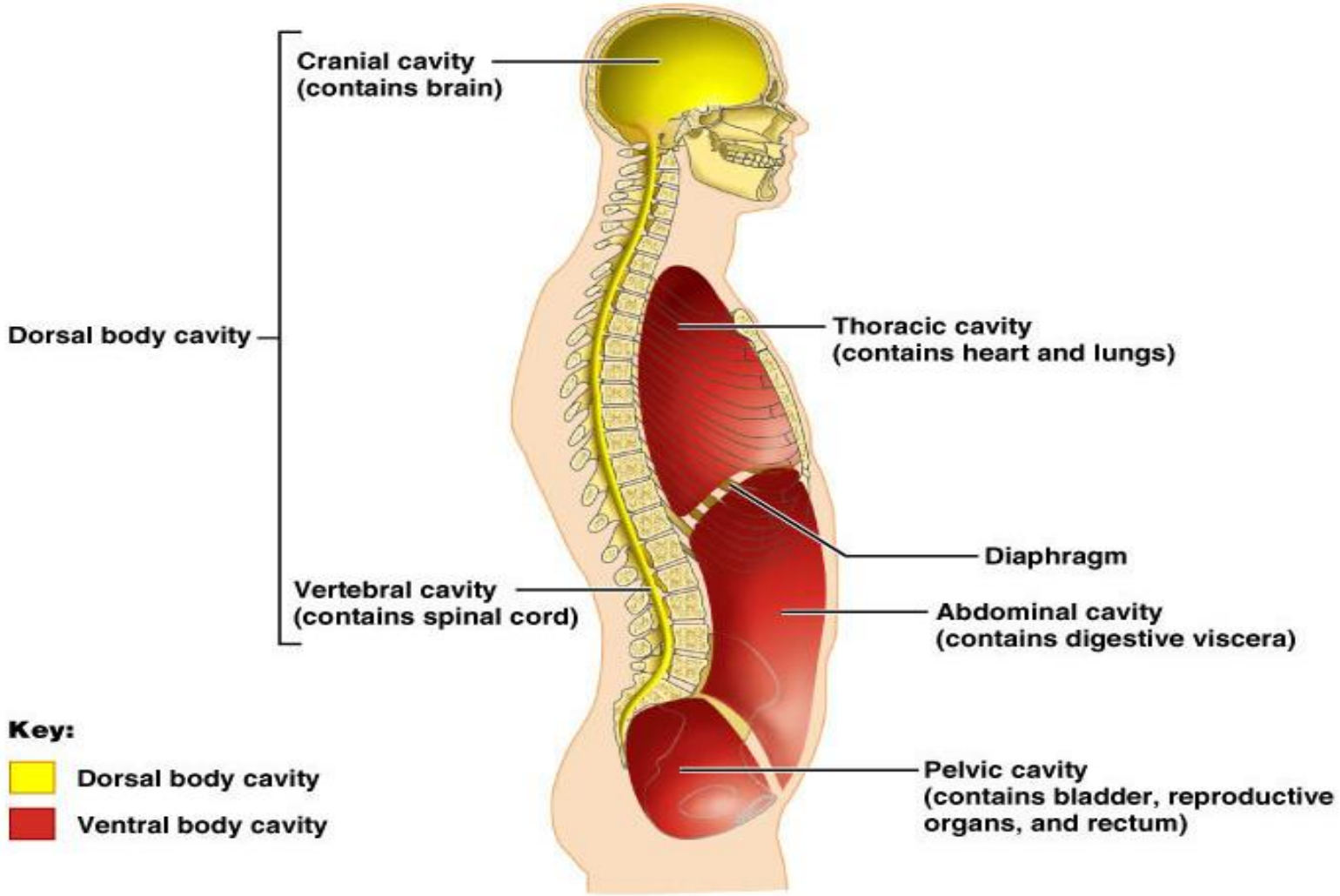
Ovulation
Oocyte and sperm transport
Fertilization
Implantation
Fetal maternal relations
Fetal circulation
Critical periods of development and
Causes of birth defects.

# BODY CAVITIES

- Cranial
- Thoracic
- Abdominal
- Pelvic

Prepared by: Madam Ruth

# Body Cavities



# BODY CAVITIES

- **Body Cavities** - Body cavities are spaces within the body that help protect, separate, and support internal organs.
  - Dorsal Body Cavity
  - Ventral Body Cavity

# Body Cavities

- **Thoracic cavity** is subdivided into pleural cavities, the mediastinal cavity, and the pericardial cavity
  - **Pleural cavities** – each houses a lung
  - **Mediastinum** – contains the pericardial cavity, and surrounds the remaining thoracic organs
  - **Pericardial cavity** – encloses the heart

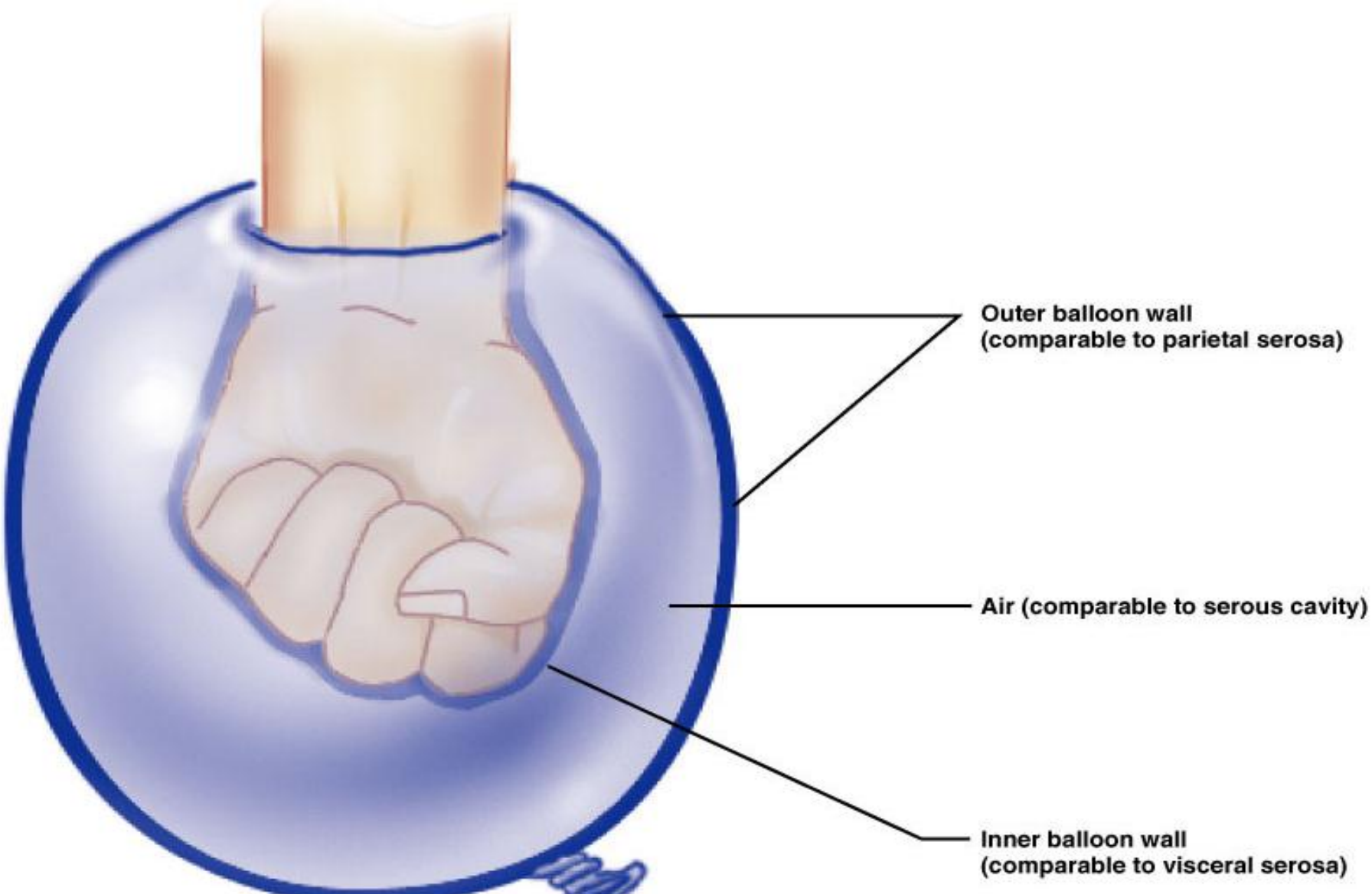
# Body Cavities

- **The abdominopelvic cavity is separated from the superior thoracic cavity by the dome-shaped diaphragm**
- It is composed of two subdivisions
  - **Abdominal cavity** – contains the stomach, intestines, spleen, liver, and other organs
  - **Pelvic cavity** – lies within the pelvis and contains the bladder, reproductive organs, and rectum

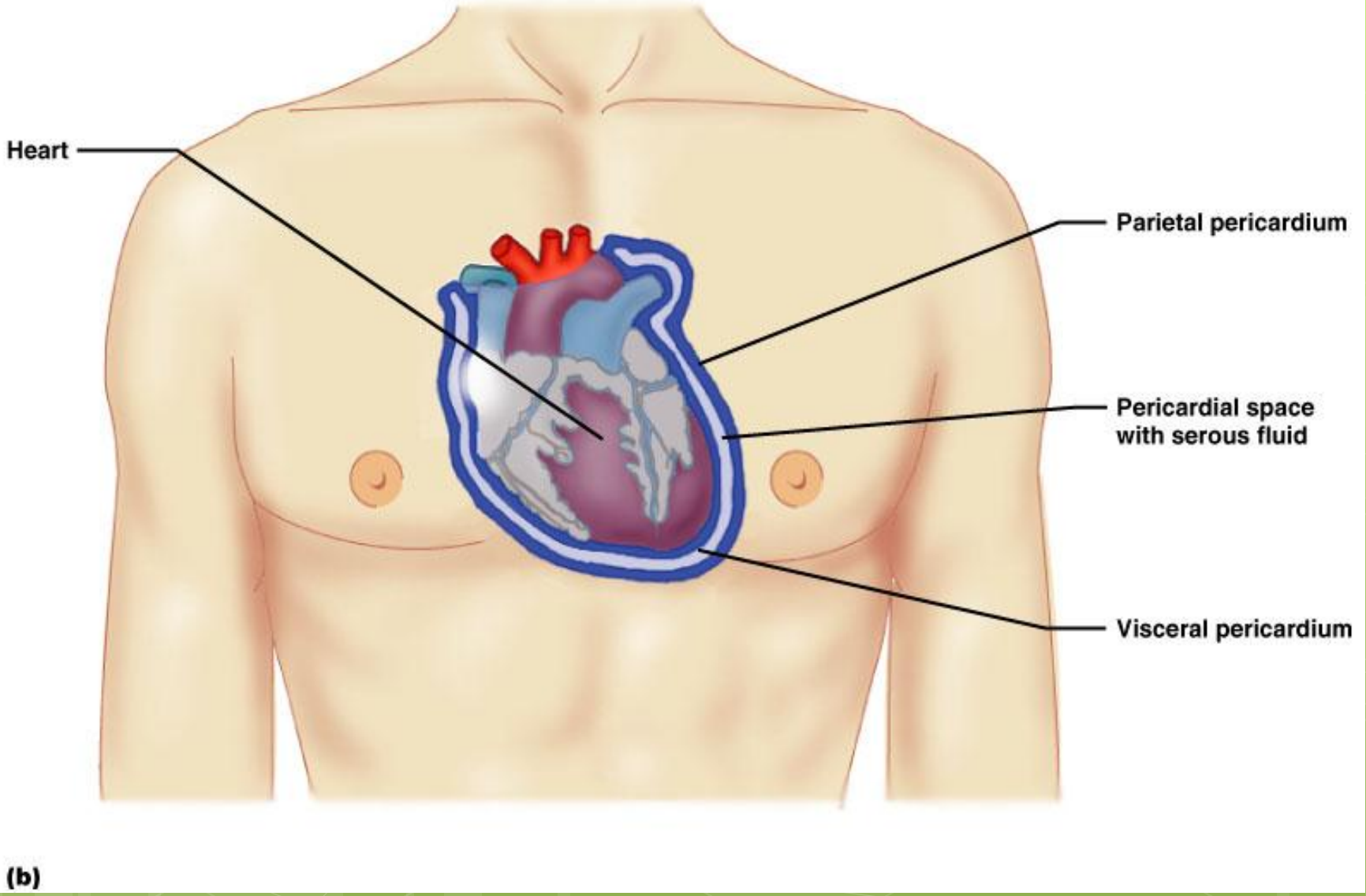
# Ventral Body Cavity Membranes

- **Parietal serosa** lines internal body walls
- **Visceral serosa** covers the internal organs
- **Serous fluid** separates the serosae

# Ventral Body Cavity Membranes



# Ventral Body Cavity Membranes



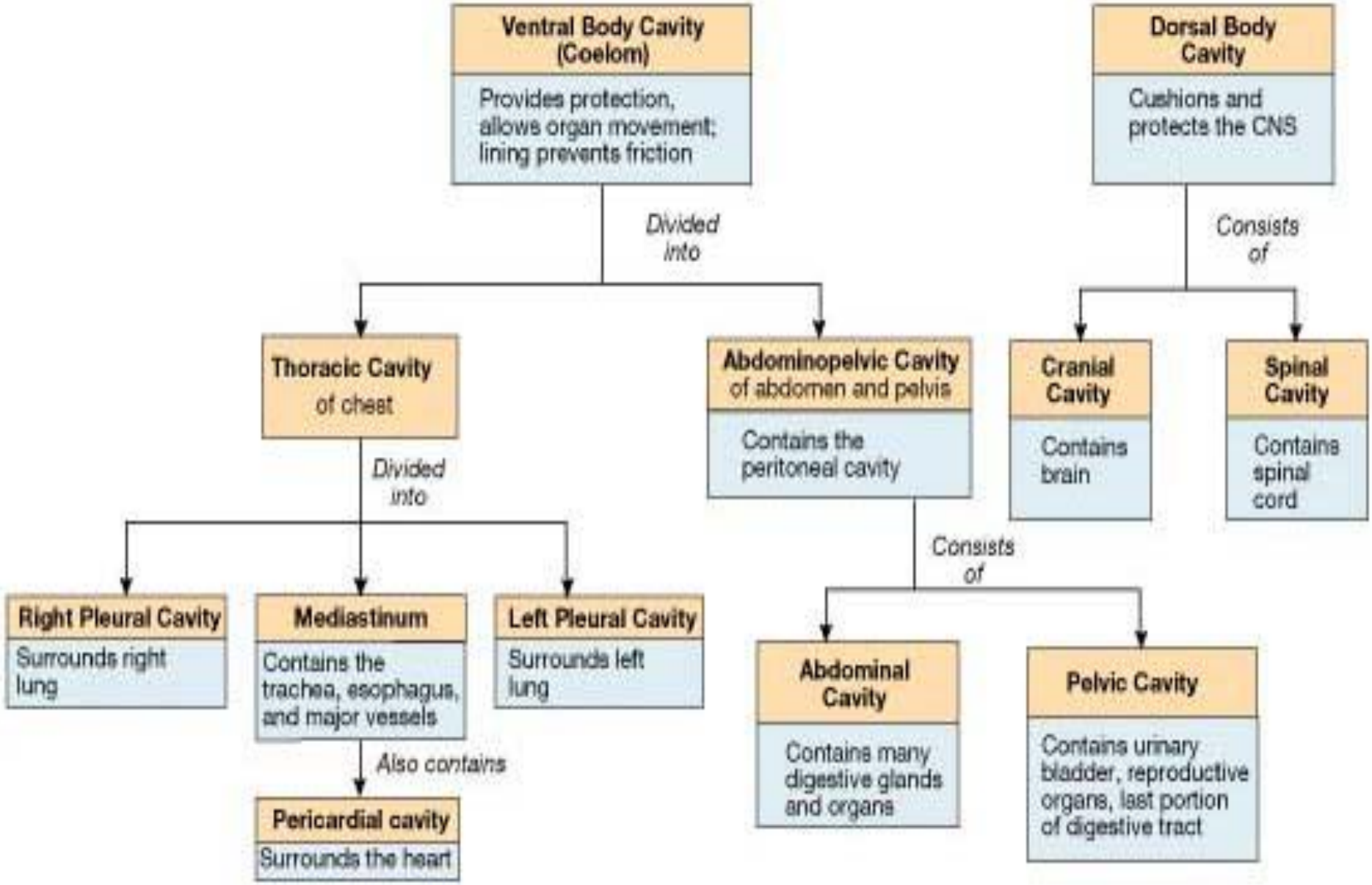



**FIGURE 1-12** Relationships of the Various Body Cavities

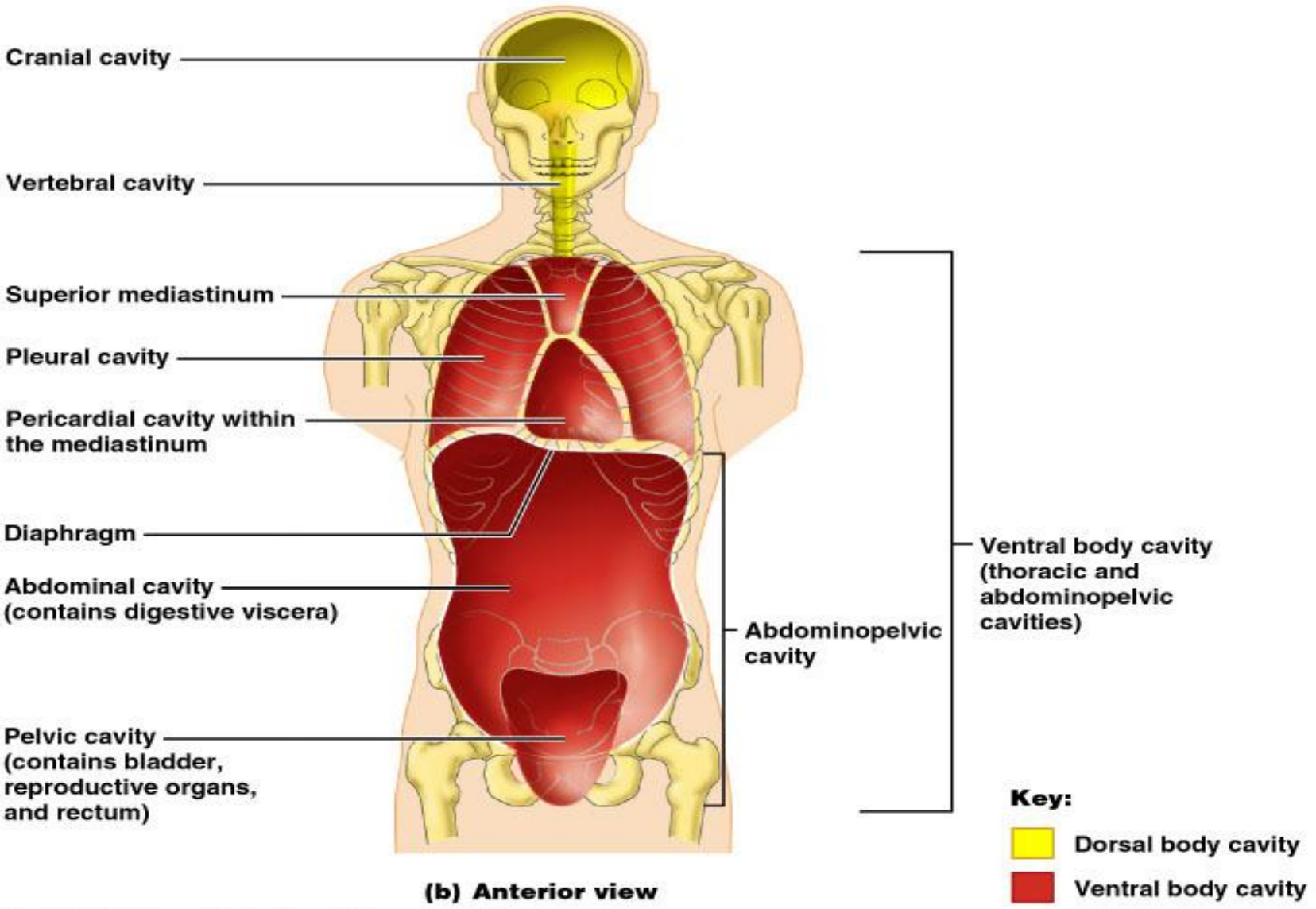
# BODY CAVITIES

- **Dorsal Body Cavity** - The dorsal body cavity is located near the dorsal (back) surface of the body and has two subdivisions, the cranial cavity and the vertebral canal.

# Body Cavities

- **Dorsal cavity** protects the nervous system, and is divided into two subdivisions
  - Cranial cavity is within the skull and encases the brain
  - Vertebral cavity runs within the vertebral column and encases the spinal cord
- **Ventral cavity** houses the internal organs (viscera), and is divided into two subdivisions: - **Thoracic** and **Abdominopelvic cavities**

# Body Cavities



# Other Body Cavities

- **Oral and digestive** – mouth and cavities of the digestive organs
- **Nasal** –located within and posterior to the nose
- **Orbital** – house the eyes
- **Middle ear** – contain bones (ossicles) that transmit sound vibrations
- **Synovial** – joint cavities

# BODY CAVITIES

- The **cranial cavity** is formed by the cranial bones and contains the brain.

# BODY CAVITIES

- The **vertebral (spinal) canal** is the spinal cord. formed by the bones of the vertebral column and contains
- Three layers of protective tissue, called meninges, line the dorsal body cavity.

# BODY CAVITIES

- **Ventral Body Cavity** - The ventral body cavity is subdivided by the diaphragm into an upper thoracic cavity and a lower abdominopelvic cavity.

# BODY CAVITIES

- The thoracic cavity contains two pleural cavities, and the mediastinum, which includes the pericardial cavity.

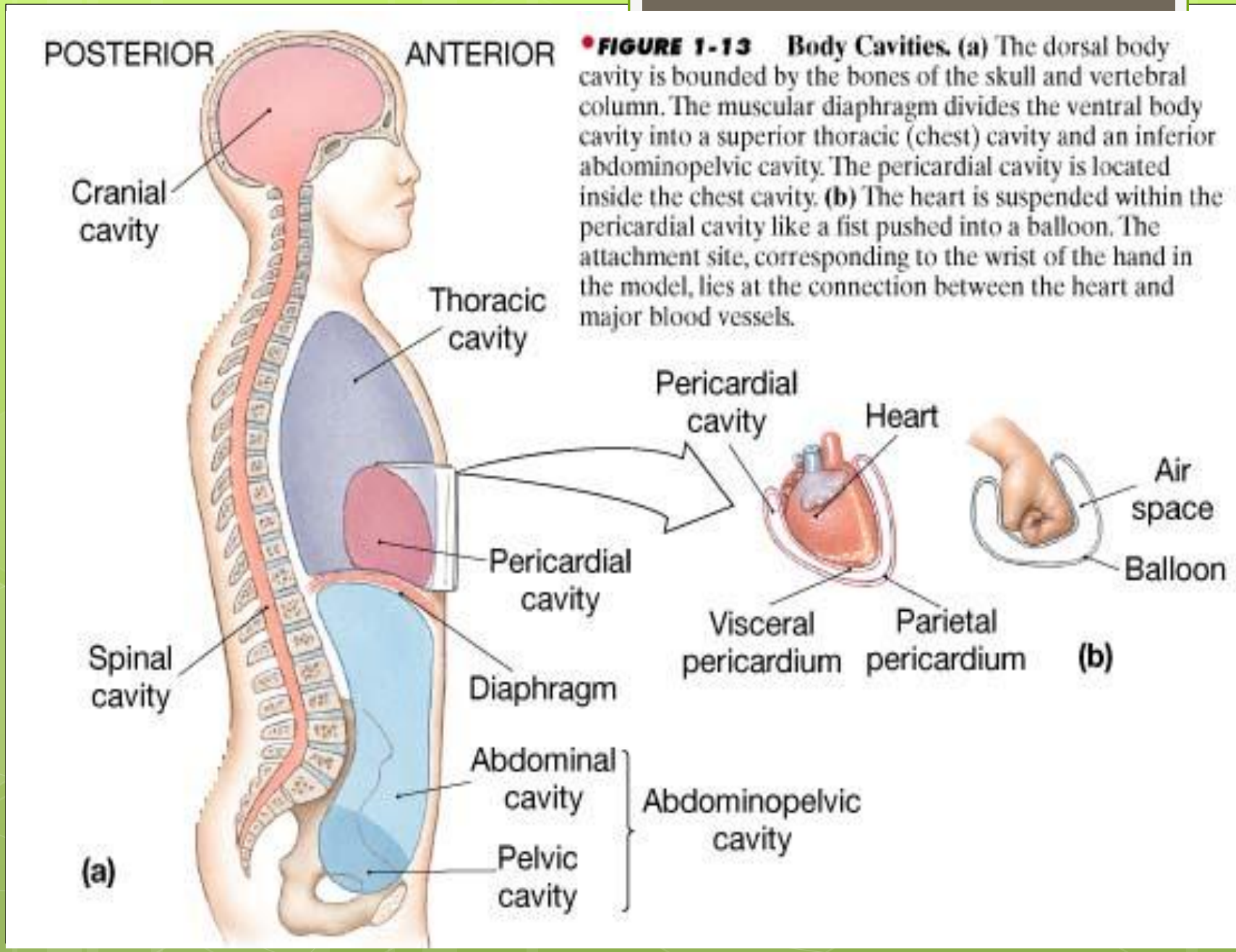
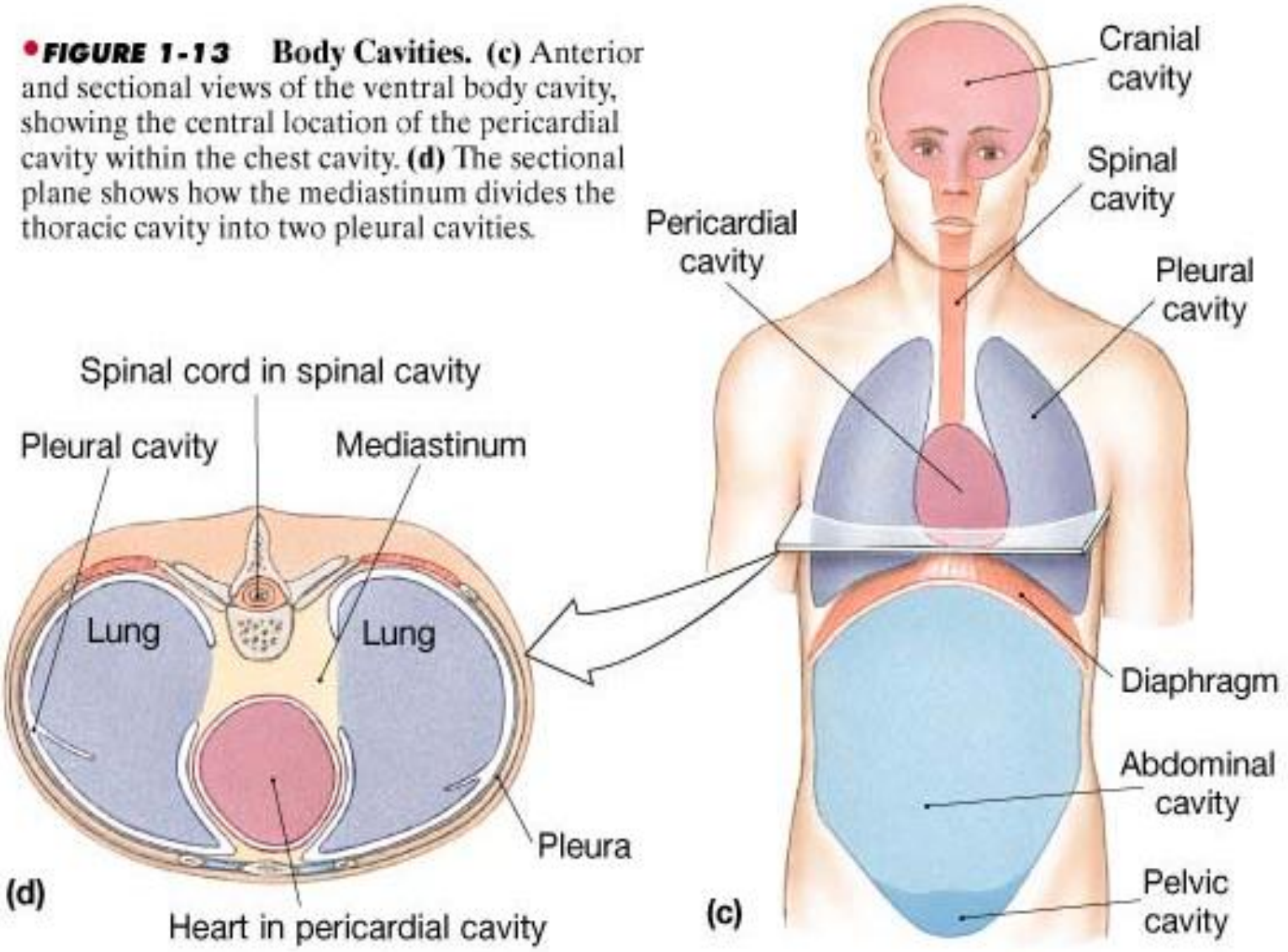



**FIGURE 1-13 Body Cavities. (a)** The dorsal body cavity is bounded by the bones of the skull and vertebral column. The muscular diaphragm divides the ventral body cavity into a superior thoracic (chest) cavity and an inferior abdominopelvic cavity. The pericardial cavity is located inside the chest cavity. **(b)** The heart is suspended within the pericardial cavity like a fist pushed into a balloon. The attachment site, corresponding to the wrist of the hand in the model, lies at the connection between the heart and major blood vessels.

**FIGURE 1-13 Body Cavities.** **(c)** Anterior and sectional views of the ventral body cavity, showing the central location of the pericardial cavity within the chest cavity. **(d)** The sectional plane shows how the mediastinum divides the thoracic cavity into two pleural cavities.



# UPPER THORACIC CAVITY

- The **pleural cavities** enclose the lungs, while the pericardial cavity surrounds the **heart**.

# UPPER THORACIC CAVITY

- The **mediastinum** is a broad, median partition between the lungs that extends from the sternum to the vertebral column, it contains all contents of the thoracic cavity except the lungs.
- The **pericardial cavity** encloses the heart and great vessels.

# ABDOMINOPELVIC CAVITY

- The abdominopelvic cavity is divided into a superior abdominal and an inferior pelvic cavity.

# Abdominopelvic Regions

- Umbilical
- Epigastric
- Hypogastric
- Right and left iliac or inguinal
- Right and left lumbar
- Right and left hypochondriac

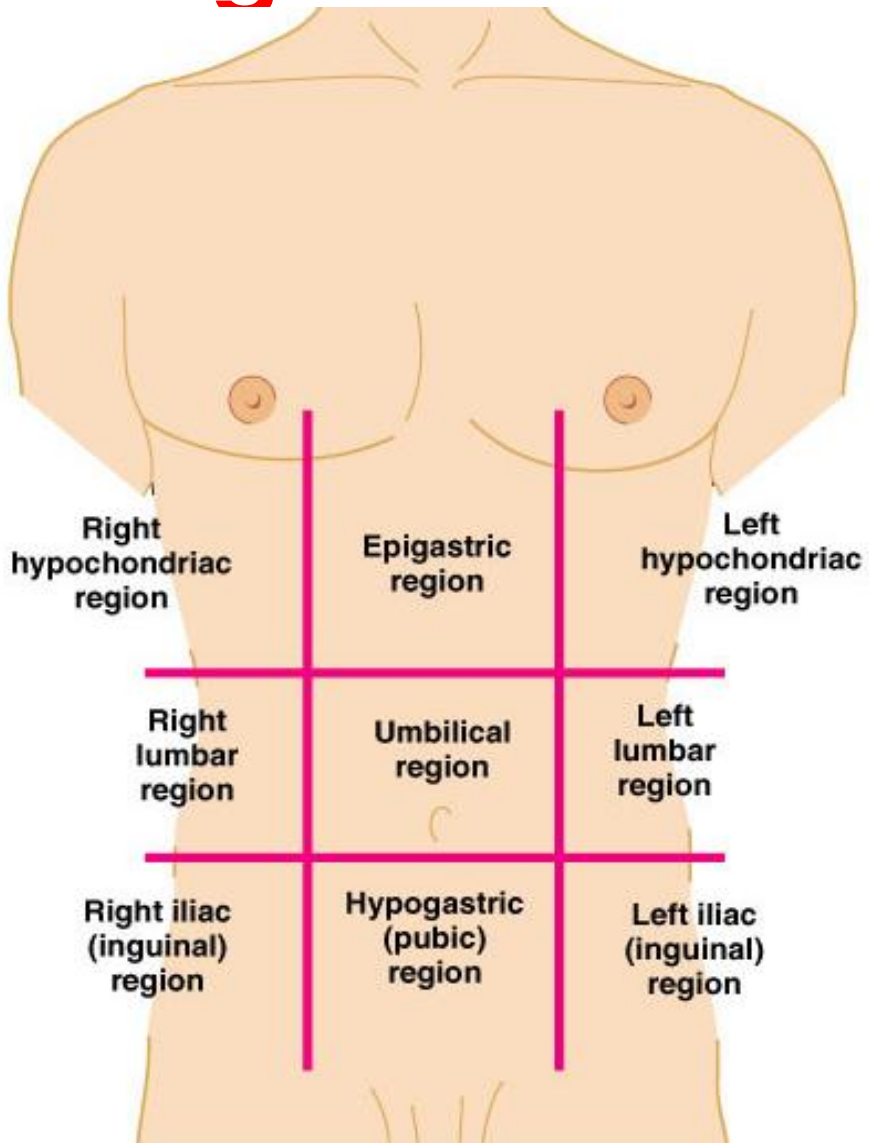



Figure 1.11a

# Organs of the Abdominopelvic Regions

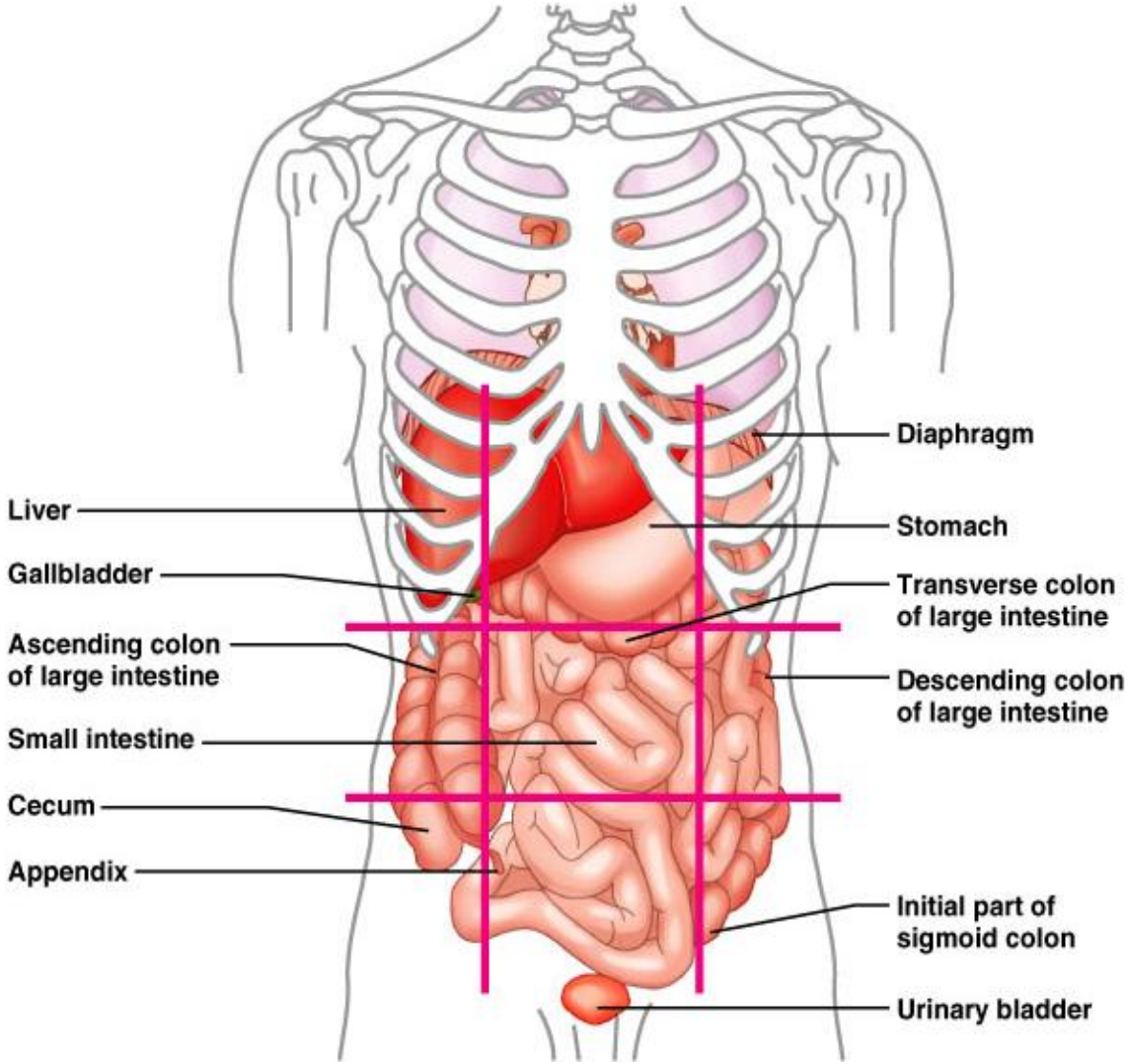



Figure 1.11b

# Abdominopelvic Quadrants

- Right upper **(RUQ)**
- Left upper **(LUQ)**
- Right lower **(RLQ)**
- Left lower **(LLQ)**

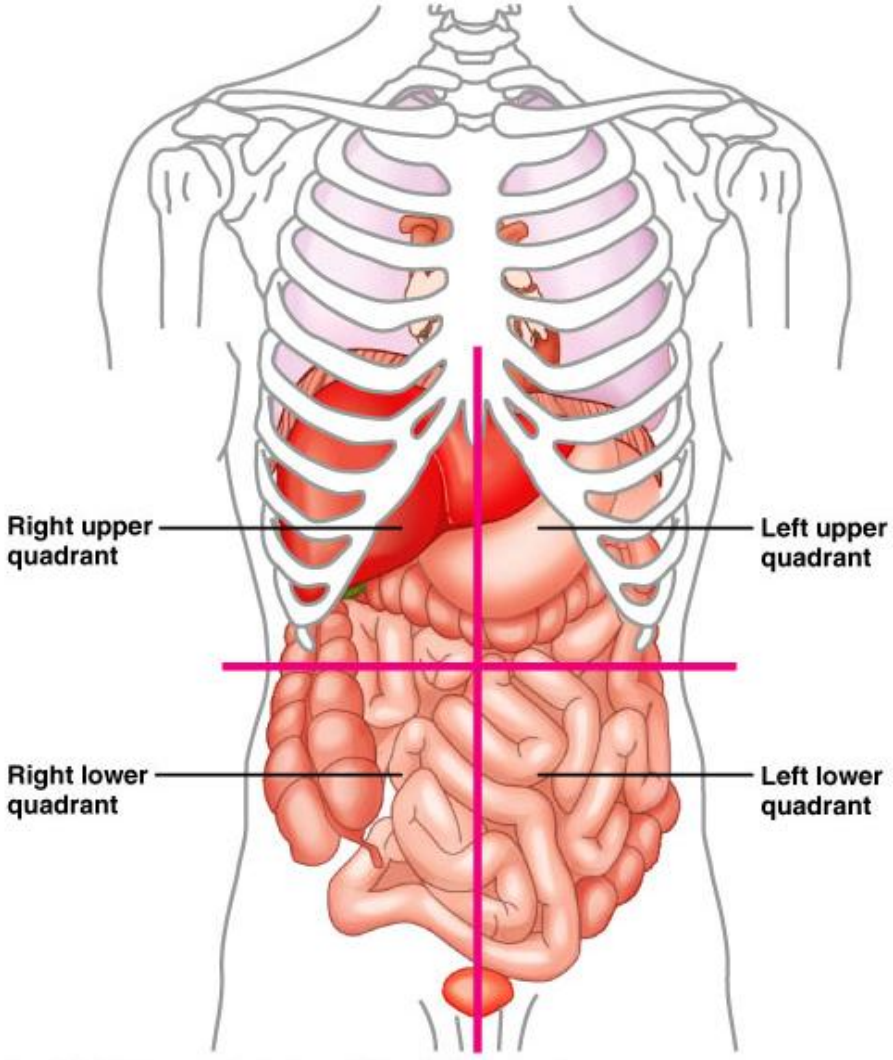



Figure 1.12

# ABDOMINOPELVIC CAVITY

- **Viscera** of the **abdominal cavity** include the stomach, spleen, pancreas, liver, gallbladder, small intestine, and most of the large intestine

# ABDOMINOPELVIC CAVITY

- **Viscera** of the **pelvic cavity** include the urinary bladder, portions of the large intestine and internal female and male reproductive structures.

# ABDOMINOPELVIC CAVITY

- Thoracic and Abdominal Cavity **Membranes:**
  - A thin, slippery **serous membrane** covers the viscera within the thoracic and abdominal cavities and also lines the walls of the thorax and abdomen.

# ABDOMINOPELVIC CAVITY

- Parts of the serous membrane are the **parietal layer** which lines the walls of the cavities and the **visceral layer** which covers and adheres to the viscera within the cavities.

# ABDOMINOPELVIC CAVITY

- **Serous fluid** between the two layers reduces friction and allows the viscera to slide somewhat during movements.
- The serous membranes include the **pleura**, **pericardium** and **peritoneum**.

# PLEURAL MEMBRANE

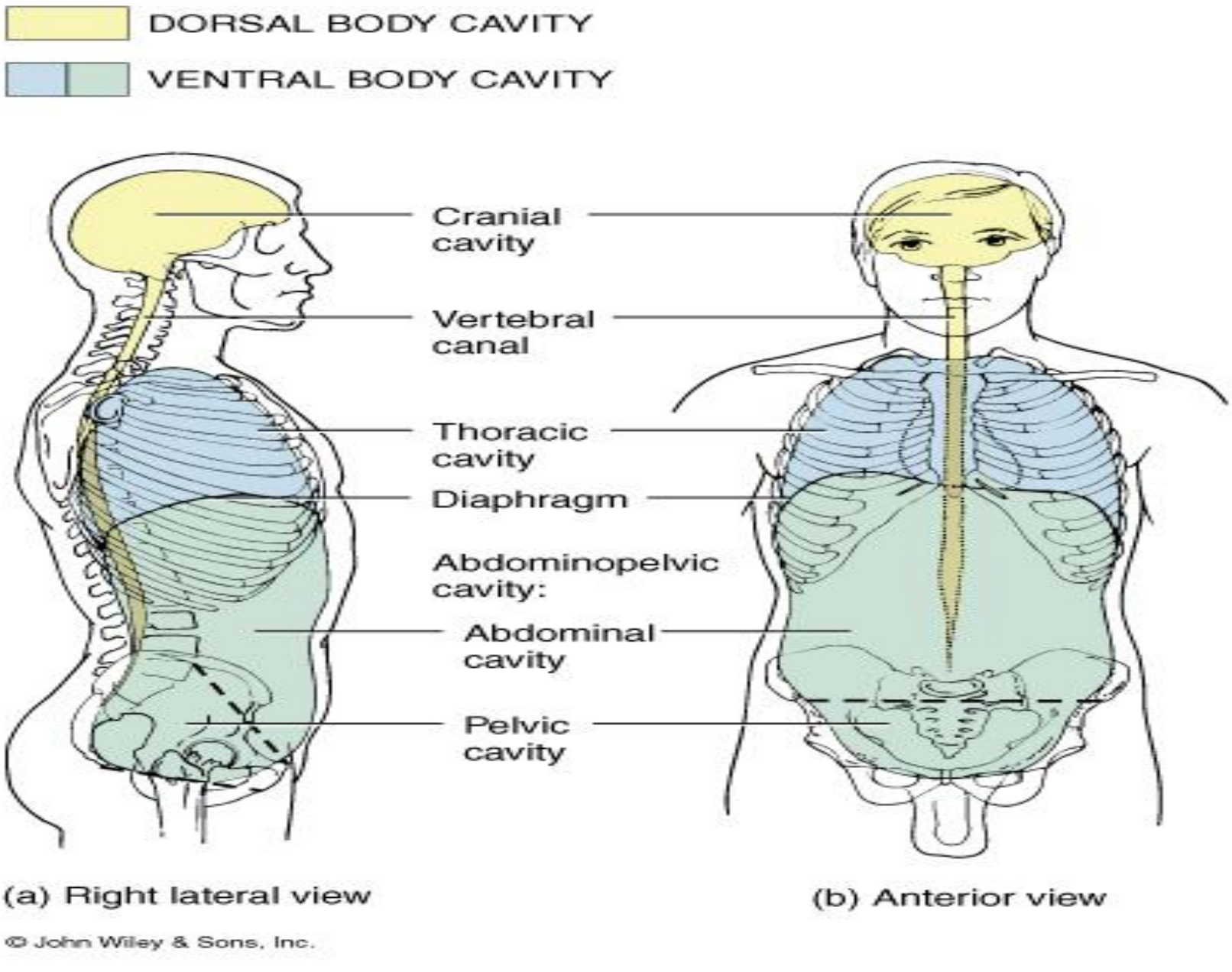
- The **pleural membrane** surrounds the lungs, with the **visceral pleura** clinging to the surface of the lungs and the **parietal pleura** lining the chest wall.

# PERICARDIUM

- The serous membrane of the pericardial cavity is the **pericardium**, with visceral pericardium covering the surface of the heart and the parietal pericardium lining the chest wall.

# PERITONEUM

- The **peritoneum** is the serous membrane of the abdominal cavity, with the visceral peritoneum covering the abdominal viscera and the parietal peritoneum lining the abdominal wall.


DORSAL BODY CAVITY
VENTRAL BODY CAVITY
Cranial cavity
Vertebral canal
Thoracic cavity
Diaphragm
Abdominopelvic cavity:
Abdominal cavity
Pelvic cavity
(a) Right lateral view
(b) Anterior view
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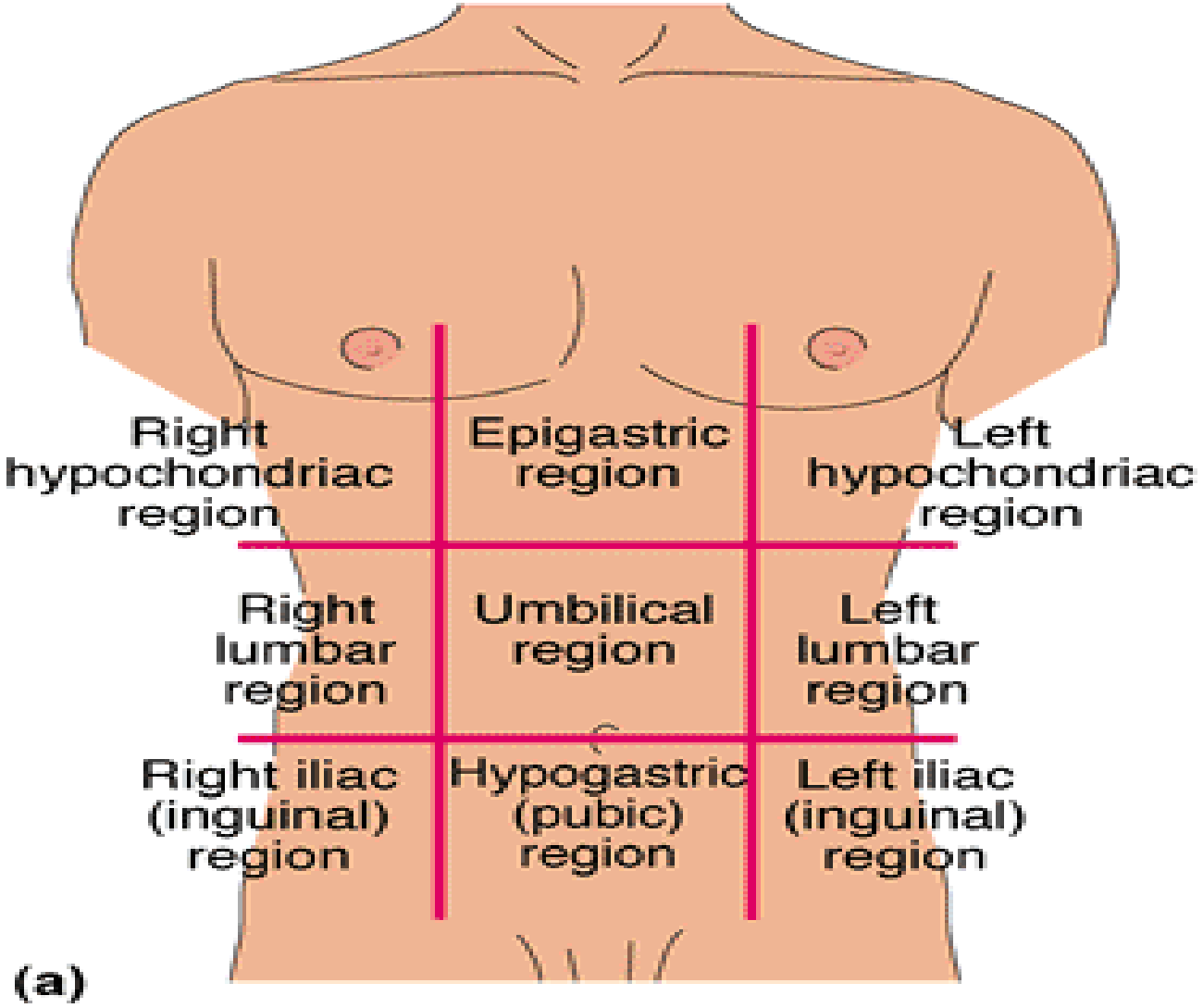
# ABDOMINOPELVIC REGIONS

- To describe the location of organs easily, the abdominopelvic cavity may be divided into **nine regions** by drawing four imaginary lines

# REGIONS


Right hypochondriac region
Epigastric region
Left hypochondriac region
Right lumbar region
Umbilical region
Left lumbar region
Right iliac (inguinal) region
Hypogastric (pubic) region
Left iliac (inguinal) region
(a)

# ABDOMINOPELVIC QUADRANTS

- To locate the site of an abdominopelvic abnormality in clinical studies, the abdominopelvic cavity may be divided into **quadrants** by passing imaginary horizontal and vertical lines through the umbilicus.

# ABDOMINOPELVIC QUADRANTS

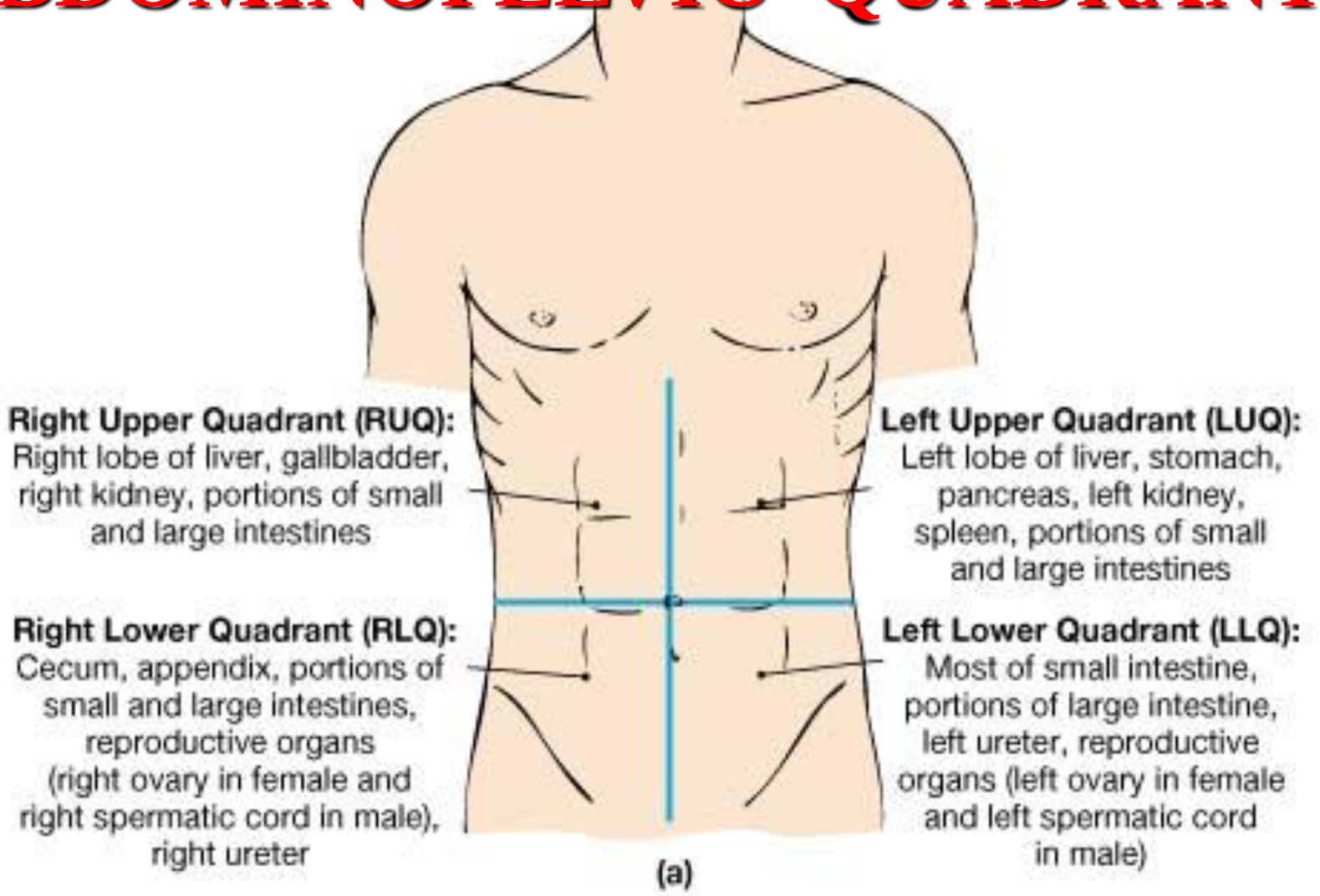



**FIGURE 1-8 Abdominopelvic Quadrants and Regions. (a)** Abdominopelvic quadrants divide the area into four sections. These terms, or their abbreviations, are most often used in clinical discussions.

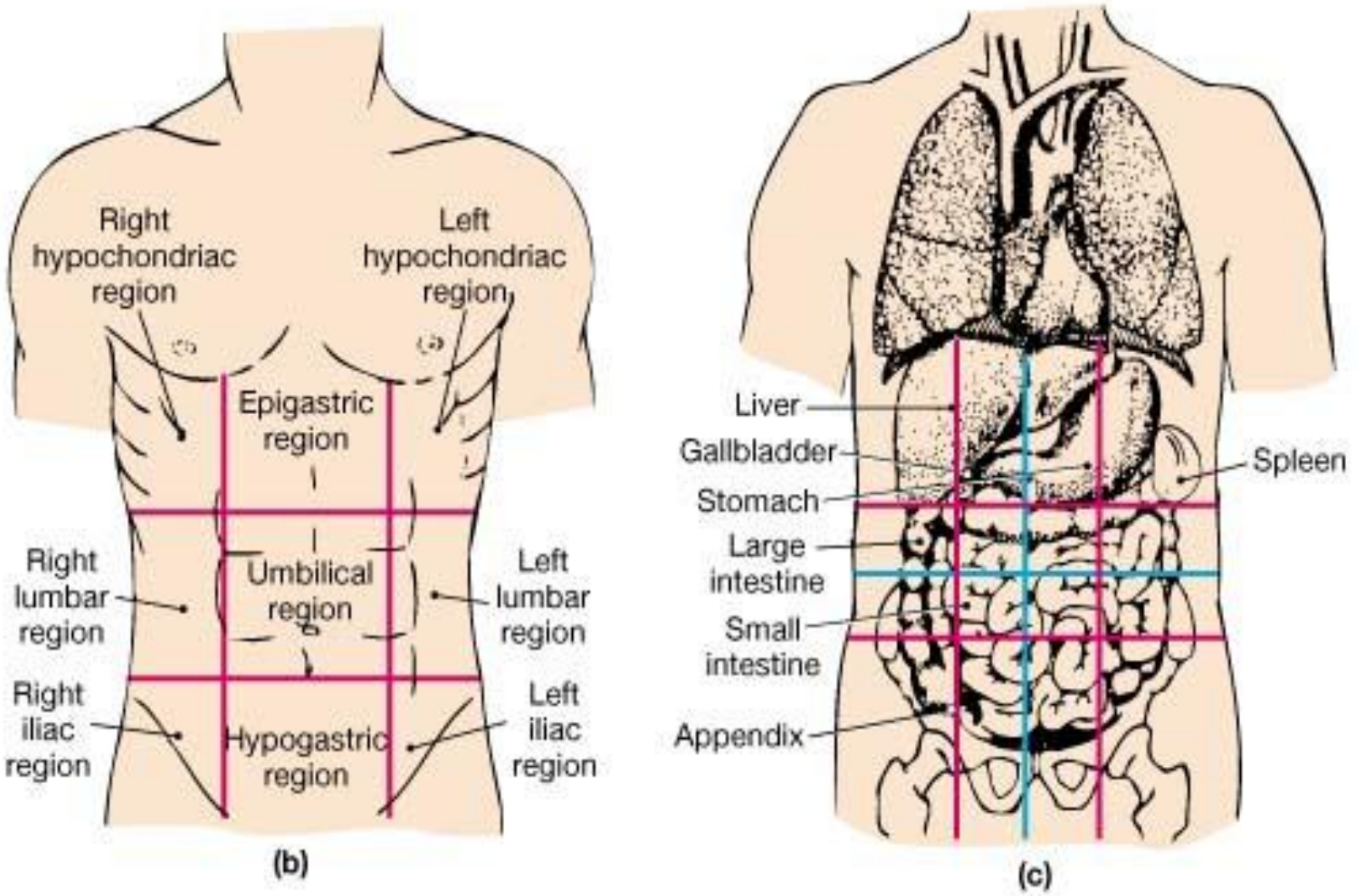



**FIGURE 1-8 Abdominopelvic Quadrants and Regions.** **(b)** More-precise regional descriptions are provided by reference to the appropriate abdominopelvic region. **(c)** Quadrants or regions are useful because there is a known relationship between superficial anatomical landmarks and underlying organs.

# ABDOMINAL QUADRANTS