

3

Cell Structures and Their Functions

FOCUS: The basic unit of the human body is the cell. The plasma membrane regulates the movement of materials into and out of the cell by diffusion, facilitated diffusion, active transport, endocytosis, and exocytosis. Chromosomes in the nucleus contain DNA

which regulates the activities of the cell by controlling protein synthesis. The cytoplasm contains organelles which are specialized to perform specific functions such as protein synthesis (ribosomes) and ATP production (mitochondria).

CONTENT LEARNING ACTIVITY

Cell Structure and Function

“The cell is the basic living unit of all organisms.”

Match these terms with the correct statement or definition:

Cytoplasm
Organelle

Nucleus
Plasma membrane

1. General term for specialized structure within cells which performs specific functions.
2. Contains the cell's genetic material and controls the cell.
3. Living material surrounding the nucleus of a cell; contains organelles.
4. Encloses the cytoplasm.

Plasma Membrane

“The plasma membrane, or cell membrane, is the outermost component of a cell.”

A. Match these terms with the correct statement or definition:

Extracellular
Intercellular

Intracellular

1. These two terms refer to substances outside the cell membrane.

2. Substances inside cells.

B. Using the terms provided, complete these statements:

Cholesterol
Nonpolar
Phospholipid

Polar
Protein

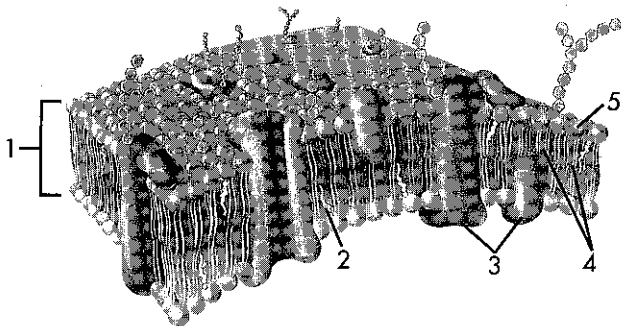
The plasma membrane consists of a double layer of (1) molecules. The (2) ends of these molecules are exposed to water inside and outside the cell, and the (3) ends form a lipid barrier between the inside and outside of the cell. Other lipids, such as (4), are interspersed among the phospholipids. According to the fluid mosaic model, (5) molecules float in the phospholipids and function as membrane channels, carrier molecules, receptor molecules, enzymes, or structural supports in the membrane.

1. _____
2. _____
3. _____
4. _____
5. _____

C. Match these terms with the correct parts labeled in Figure 3-1:

Cholesterol
Phospholipids
Polar end
Nonpolar end
Proteins

1. _____
2. _____
3. _____
4. _____
5. _____



Organelles and Cell Functions

“Organelles are specialized structures within cells that perform specific functions.”

A. Match these terms with the correct statement or definition:

Nucleus
Nucleolus
Ribosome

Rough ER
Smooth ER

1. Large, membrane-bounded structure usually located near the center of the cell.
2. Contains chromosomes (DNA) which determine the structure and function of the cell.
3. Site of ribosomal subunit production.
4. Site of protein synthesis.
5. Membrane without ribosomes; site of lipid synthesis.



Ribosomal subunits leave the nucleus through nuclear pores.

B. Match these terms with the correct statement or definition:

Golgi apparatus
Mitochondria

Lysosome
Secretory vesicle

1. Closely packed stacks of membranes; collects, modifies, packages, and distributes protein and lipid molecules.
2. Membrane-bounded sac that pinches off from the Golgi apparatus and releases its contents to the cell's exterior.
3. Membrane-bounded sac containing digestive enzymes.
4. Rod-shaped organelles with an inner and outer membrane; major site of ATP production (oxidative metabolism).

C. Match these terms with the correct statement or definition:

Cytoskeleton
Intermediate filaments

Microfilaments
Microtubules

1. General term for proteins that support the cell and make possible cell movements.
2. Hollow protein tubules; assist in cell division and help to form cilia and flagella.
3. Protein fibrils that enable muscle cells to contract.
4. Protein fibrils that are smaller than microtubules and larger than microfilaments; provide mechanical support.

D. Match these terms with the correct statement or definition:

Cilia
Flagellum

Microvilli

1. Projections from the cell surface that move materials embedded in mucus.
2. A long projection from the cell surface that functions to move a sperm cell.
3. Specialized extensions of the cell membrane that increase the surface area of cells; important in absorption of materials.

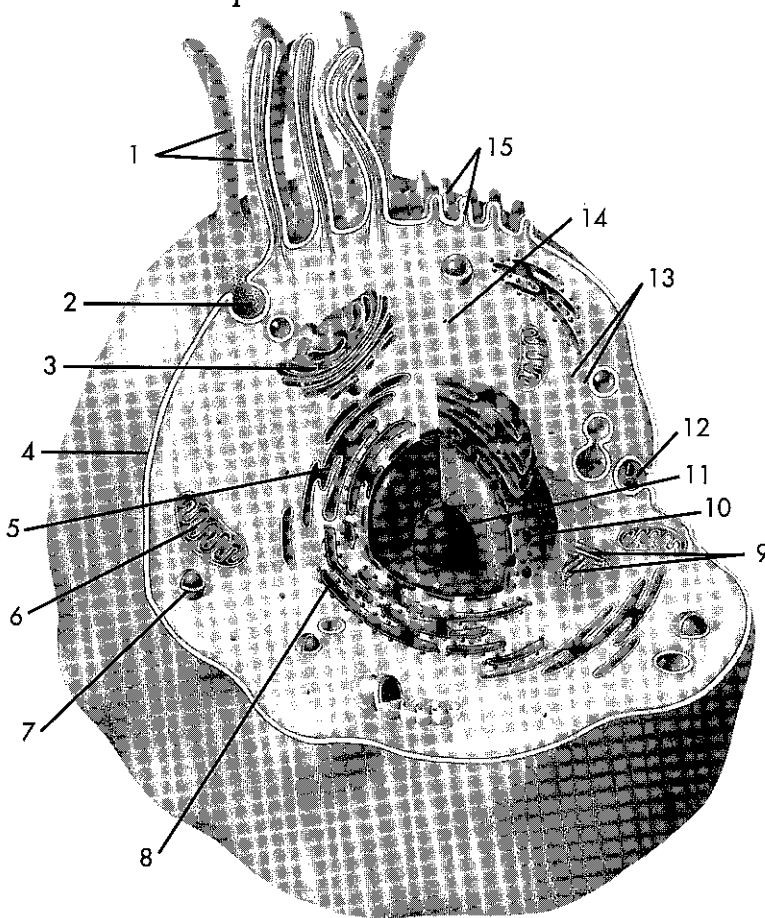
Cell Diagram

Match these terms with the cell parts labeled in Figure 3-2:

Centrioles
Cilia
Golgi apparatus
Lysosomes
Microtubules
Microvilli
Mitochondrion
Nuclear envelope

Nucleolus
Phagocytic vesicle
Plasma membrane
Ribosome
Rough endoplasmic reticulum
Secretory vesicle
Smooth endoplasmic reticulum

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____



Movement Through the Plasma Membrane

“The plasma membrane is selectively permeable, allowing some substances to pass through it but not others.”

Match these terms with the correct statement or definition:

Carrier molecules
Double layer of lipids

Membrane channels
Vesicles

- _____ 1. Molecules that are soluble in lipids dissolve in this.
- _____ 2. Allows molecules of only a certain size range to pass through.
- _____ 3. Large molecules that are not lipid soluble are transported by these proteins.
- _____ 4. Membrane-bound sacs that transport large nonlipid-soluble molecules, small pieces of matter, and even whole cells.
- _____ 5. Sodium and potassium ions are transported through these.
- _____ 6. Glucose and amino acids are transported by these.



Because of the membrane's permeability characteristics and its ability to transport certain molecules, cells are able to maintain proper intracellular concentrations of molecules.

Diffusion

“Diffusion is an important means by which substances move through the extracellular and intracellular fluids in the body.”

Match these terms with the correct statement or definition:

Diffusion
Solute

Solvent

- _____ 1. Predominant liquid or gas in a solution.
- _____ 2. Substance dissolved in the solvent.
- _____ 3. Tendency for solute molecules to move from an area of higher concentration to an area of lower concentration in solution.
- _____ 4. Process involving the constant random movement of all atoms, molecules, or ions in a solution.



A concentration gradient is a measure of the difference in concentration of a solute in a solvent between two points.

Osmosis and Filtration

“Osmosis is important to cells because large volume changes caused by water movement can disrupt normal cell functions.”

Match these terms with the correct statement or definition:

Crenation
Filtration
Hypotonic
Hypertonic

Isotonic
Lysis
Osmosis
Osmotic pressure

- _____ 1. Diffusion of water across a selectively permeable membrane.
- _____ 2. The force required to prevent the movement of water across a selectively permeable membrane.
- _____ 3. When a cell is placed in this type of solution it shrinks.
- _____ 4. Rupture of a cell placed in hypotonic solution.
- _____ 5. Movement of a solution through a membrane in response to a pressure difference; some substances pass through the membrane but others don't.

Mediated Transport Mechanisms

“Mediated transport mechanisms involve carrier molecules that move large, water soluble or electrically charged molecules across the plasma membrane.”

Match these terms with the correct statement or definition:

Active transport
Facilitated diffusion

- _____ 1. Only moves substances from a higher to a lower concentration.
- _____ 2. Does not require metabolic energy (ATP).
- _____ 3. Can move substances against their concentration gradient.
- _____ 4. May exchange one substance for another. For example, the sodium-potassium exchange pump.

Endocytosis and Exocytosis

“Endocytosis and exocytosis use vesicles to move substances across the plasma membrane.”

Match these terms with the correct statement or definition:

Endocytosis
Exocytosis

Phagocytosis
Pinocytosis

- _____ 1. Includes both phagocytosis and pinocytosis.
- _____ 2. Means cell eating and is the ingestion of solid particles.
- _____ 3. Secretory vesicles fuse with the plasma membrane, and the contents of the vesicle are eliminated from the cell.

Protein Synthesis

“Events that lead to protein synthesis begin in the nucleus and end in the cytoplasm.”

Match these terms with the correct statement or definition:

mRNA
rRNA
tRNA

Transcription
Translation

- _____ 1. This process occurs when the double strands of a DNA segment separate, and RNA nucleotides pair with DNA nucleotides.
- _____ 2. RNA that carries information in groups of three nucleotides called codons, and each codon codes for a specific amino acid.
- _____ 3. RNA that has an anticodon and binds to a specific amino acid.
- _____ 4. This process involves the synthesis of polypeptide chains at the ribosome in response to the information contained in mRNA molecules.



The proteins produced in a cell function as enzymes or structural components inside and outside the cell.

Mitosis

“Nearly all cell divisions in the body occur by mitosis, and the resultant "daughter" cells have the same amount and type of DNA as the "parent" cell.”

A. Match these terms with the correct statement or definition:

Autosomes
Diploid

XX
XY

- _____ 1. The number of chromosomes in most body cells; 46 in humans.
- _____ 2. The name of chromosomes other than the sex chromosomes.
- _____ 3. The sex chromosomes found in a female.

B. Match these terms with the correct statement or definition:

Anaphase
Interphase
Metaphase

Prophase
Telophase

- _____ 1. Time of DNA replication; not one of the four phases of mitosis.
- _____ 2. Chromosomes become visible in this phase.
- _____ 3. Chromosomes align along the center of the cell.
- _____ 4. Chromosomes move toward the poles of the cell.
- _____ 5. Chromosomes begin to unravel and resemble the genetic material during interphase.

C. Match these terms with the correct statement or definition:

Centriole
Centromere

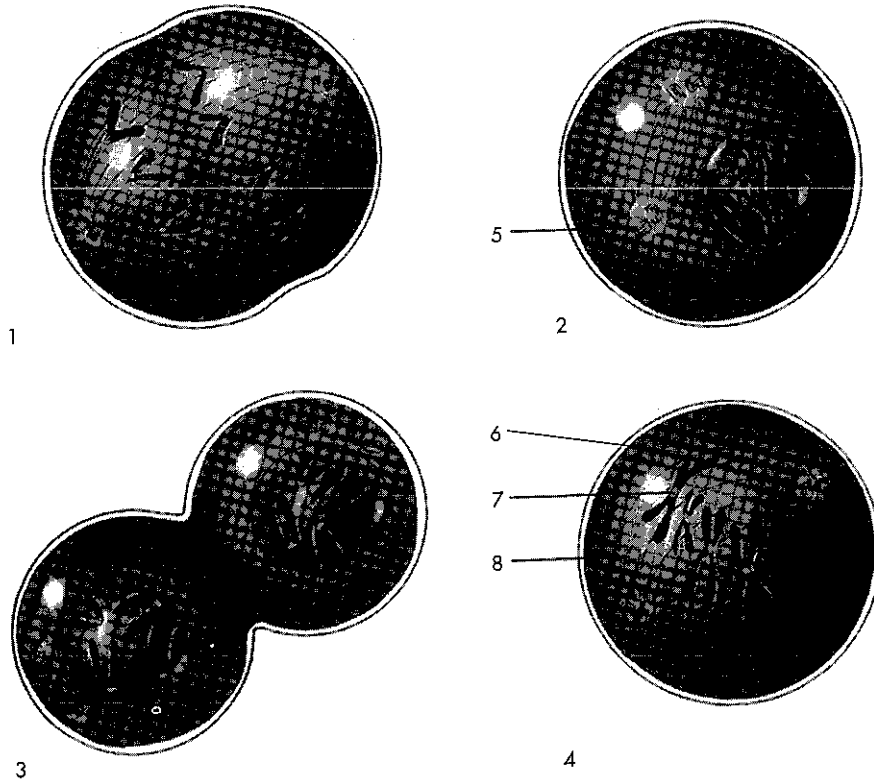
Chromatids
Spindle fibers

1. The two strands that make up a chromosome after interphase.
2. The specialized region that links chromatids together.
3. Moves the chromosomes toward the poles of the cell.

D. Match these terms with the phases of mitosis and the cell parts involved in mitosis labeled in Figure 3-3:

Anaphase
Centriole
Centromere
Chromatid

Metaphase
Prophase
Spindle fiber
Telophase



- | | | |
|----------|----------|----------|
| 1. _____ | 4. _____ | 7. _____ |
| 2. _____ | 5. _____ | 8. _____ |
| 3. _____ | 6. _____ | |

Meiosis

“Meiosis is the formation of sex cells.”

Match these terms with the correct statement or definition:

Crossing over
Haploid
Interkinesis

Gametes
Random distribution
Tetrad

- _____ 1. Sex cells such as sperm cells or oocytes.
- _____ 2. The number of chromosomes in a sex cell; 23 in humans.
- _____ 3. Four chromatids of a pair of chromosomes.
- _____ 4. Time between the first and second meiotic division.
- _____ 5. Two things responsible for genetic diversity.
- _____

Differentiation

“The human body is composed of many different kinds of cells.”

Using the terms provided, complete these statements:

The same
Different

Differentiation

All the cells in the body arise from a single fertilized egg. The DNA in these cells is (1). The process by which cells develop specialized structures and functions is called (2). One type of specialized cell (e.g., bone cell) has (3) DNA as another type of specialized cell (e.g., fat cell). The reason specialized cell types are different from each other is because they have (4) parts of their DNA active.

1. _____
2. _____
3. _____
4. _____

QUICK RECALL

Complete the following chart by writing in the organelle described by the structures and functions listed.

<u>ORGANELLE</u>	<u>STRUCTURE</u>	<u>FUNCTION</u>
1. _____	Membrane-bound sac pinched off from the Golgi apparatus.	Contents released to the exterior of the cell by exocytosis.
2. _____	Series of membranes that extend from the outer nuclear membrane; no ribosomes attached.	Lipid synthesis
3. _____	Surrounded by double-layered envelope with pores.	Contains DNA in the form of chromatin (chromosomes) which produces RNA.
4. _____	Composed of hollow protein tubules.	Support for the cytoplasm of the cell; involved in cell division; essential component of cilia and flagella.
5. _____	Small extensions of the cell membrane supported by microfilaments.	Increase cell surface area for absorption.
6. _____	Closely packed stacks of curved membrane-bound sacs.	Modifies, packages, and distributes proteins and lipids.
7. _____	Two subunits composed of ribosomal RNA and protein.	Site where mRNA and tRNA come together to assemble amino acids into proteins.
8. _____	Membrane-bound vesicle containing intracellular digestive enzymes.	Breakdown of phagocytized particles; autophagia.
9. _____	Small, bean-shaped or rod-shaped organelle; double membrane with infoldings of the inner membrane called cristae.	Most ATP synthesis in the cell (oxidative metabolism).
10. _____	Small organelles that divide and migrate to each pole of the cell during cell division	Chromosomes move toward them during cell division.

- | | | |
|-----------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 11. _____ | Series of membranes that extend from the outer nuclear membrane; ribosomes attached. | Synthesis of proteins. |
| 12. _____ | One to four rounded, dense, well-defined nuclear bodies. | Production of ribosomal subunits. |
| 13. _____ | Appendages from the surface of the cell; contain microtubules. | Movement of materials over the surface of the cells. |
| 14. _____ | Similar to cilia but much longer; usually one per cell. | Propels sperm cells. |
| 15. _____ | Small protein fibrils. | Provide structure to cytoplasm and mechanical support to microvilli; responsible for muscle's ability to contract. |
| 16. _____ | Protein fibrils, intermediate in size between microtubules and microfilaments. | Provide mechanical support to the cell. |

17. List the two major types of molecules found in the plasma membrane and give their functions.

18. List eight ways materials (including water) can cross a membrane.

19. List three terms used to describe the tendency of cells to shrink or swell when placed in a solution.

20. Name the two steps that occur during protein synthesis.

21. Name in order the four stages of mitosis.

WORD PARTS

Give an example of a new vocabulary word that contains each word part.

WORD PART	MEANING	EXAMPLE
intra-	within	1. _____
inter-	between	2. _____
iso-	equal	3. _____
hypo-	under; less than	4. _____
hyper-	over; above	5. _____
-some	body	6. _____

MASTERY LEARNING ACTIVITY

Place the letter corresponding to the correct answer in the space provided.

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>_____ 1. Cytoplasm is</p> <ul style="list-style-type: none"> a. called the control center of the cell. b. found surrounding the nucleus. c. responsible for regulating what materials enter or exit the cell. d. assembled within the nucleolus. | <p>_____ 4. Which of the following organelles would one expect to be present in a cell responsible for producing lipids?</p> <ul style="list-style-type: none"> a. rough endoplasmic reticulum b. smooth endoplasmic reticulum c. lysosomes d. centrioles |
| <p>_____ 2. Which of the following are functions of the proteins found in cell membranes?</p> <ul style="list-style-type: none"> a. membrane channels b. carrier molecules c. enzymes d. receptor molecules e. all of the above | <p>_____ 5. The cell organelle that modifies and packages material to be secreted is the</p> <ul style="list-style-type: none"> a. nucleolus. b. ribosome. c. mitochondria. d. Golgi apparatus. |
| <p>_____ 3. A large structure normally visible in the nucleus of a cell?</p> <ul style="list-style-type: none"> a. endoplasmic reticulum b. mitochondrion c. nucleolus d. lysosome | <p>_____ 6. Which of the following organelles produces large amounts of ATP?</p> <ul style="list-style-type: none"> a. nucleus b. mitochondria c. ribosomes d. endoplasmic reticulum |

- _____ 7. Lipid-soluble molecules diffuse through the _____; water soluble molecules diffuse through the _____.
- membrane channels; membrane channels
 - membrane channels; plasma membrane
 - plasma membrane; membrane channels
 - plasma membrane; plasma membrane
- _____ 8. Container A contains a 10% salt solution and container B a 20% salt solution. If the two solutions were connected, the net movement of water by diffusion would be from _____ to _____, and the net movement of the salt by diffusion would be from _____ to _____.
- A, B, A, B
 - A, B, B, A
 - B, A, A, B
 - B, A, B, A
- _____ 9. Which of the following statements is true about facilitated diffusion?
- Net movement is with the concentration gradient.
 - It requires the expenditure of energy (ATP).
 - It does not require a carrier molecule.
 - It moves materials through membrane channels.
- _____ 10. A process that uses vesicles to move liquid (not particulate matter) into cells is
- diffusion.
 - pinocytosis.
 - phagocytosis.
 - exocytosis.
- _____ 11. A portion of a mRNA molecule that determines one amino acid in a polypeptide chain is called a
- anticodon.
 - codon.
 - nucleotide.
 - translator.
- _____ 12. In which of the following organelles is mRNA synthesized?
- nucleus
 - ribosome
 - endoplasmic reticulum
 - lysosome
- _____ 13. The organelle of the cell that serves as the site of protein synthesis?
- ribosome
 - vesicle
 - Golgi apparatus
 - nucleolus
- _____ 14. Transfer RNA
- is used to transcribe mRNA.
 - binds to amino acids and has an anticodon.
 - duplicates itself during interphase.
 - is a type of enzyme.
- _____ 15. Given the following activities:
- repair
 - growth
 - gamete production
 - differentiation
- Which of the activities are the result of mitosis?
- 2
 - 3
 - 1, 2
 - 3, 4
 - 1, 2, 4
- _____ 16. Chromatids
- are duplicated DNA molecules.
 - are joined at the centromere.
 - become chromosomes at anaphase.
 - all of the above
- _____ 17. The stage of mitosis in which the chromosomes unravel and new nuclei are formed?
- anaphase
 - metaphase
 - prophase
 - telophase

- _____ 18. The major function of meiosis is to ensure that each of the resultant daughter cells
- a. has the same number and kind of chromosomes as the parent cell.
 - b. has one half the number of chromosomes as the parent cell.
 - c. has only autosomal chromosomes
 - d. none of the above
- _____ 19. Crossing over
- a. occurs during mitosis.
 - b. is an exchange of genetic material between chromatids.
 - c. decreases genetic variability.
 - d. establishes the sex of the individual.
- _____ 20. The sex of individuals is determined by their sex chromosomes. An individual is male if he has chromosomes
- a. MM.
 - b. MF.
 - c. XX.
 - d. XY.