

Chapter 7: A Tour of the Cell

This chapter covers the main organelles you learned in your Honors/Regents Biology class along with some others you did not. We will be going through this chapter rather quickly. The questions that follow should help you focus on the most important points. If you have any problems – please see me after school for additional help.

OBJECTIVES:

How We Study Cells

- ___1. Distinguish between magnification and resolving power.
- ___2. Describe the principles, advantages, and limitations of the light microscope, transmission electron microscope, and scanning electron microscope.
- ___3. Describe the major steps of cell fractionation and explain why it is a useful technique.

A Panoramic View of the Cell

- ___4. Distinguish between prokaryotic and eukaryotic cells.
- ___5. Explain why there are both upper and lower limits to cell size.
- ___6. Explain why compartmentalization is important in eukaryotic cells.

The Nucleus and Ribosomes

- ___7. Describe the structure and function of the nucleus and briefly explain how the nucleus controls protein synthesis in the cytoplasm.
- ___8. Describe the structure and function of a eukaryotic ribosome.

The Endomembrane System

- ___9. List the components of the endomembrane system, describe their structures and functions, and summarize the relationships among them.
- ___10. Explain how impaired lysosomal function can cause the symptoms of storage diseases.
- ___11. Describe the different structures and functions of vacuoles.
- ___12. Describe the structure of a mitochondrion and explain the importance of compartmentalization in mitochondrial function.

Evolution, Unity, and Diversity

- ___13. Identify the three functional compartments of a chloroplast. Explain the importance of compartmentalization in chloroplast function.

Other Membranous Organelles

- ___14. Explain the roles of mitochondria and chloroplasts.

Guided Reading: Chapter 7

- (p.110) 1. The development of electron microscopes has further opened our window on the cell and its organelles. What are the advantages and disadvantages of using an electron microscopes?

Advantages:

- magnification
- resolving power (*clarity*)

Disadvantages:

- can only be used with nonliving specimens

- (p.110) 2. Study the electron micrographs on page 110 of your text. Describe the different types of images obtained from and limitations to:

(a) **scanning electron microscopy (SEM)**

Cell biologists use SEM to study the surface of a specimen resulting in an image of the topography of the specimen. However, the methods used to prepare the specimen kills the cells and may introduce artifacts and structural features that do not exist in living cells.

(b) **transmission electron microscopy (TEM)**

Cell biologists use TEM to study the internal ultrastructure of cells. Images can be focused on a screen or on photographic film.

- (p.109) 3. What is **resolving power** and why is it important in biology? **Nobel Prize 2014**

Resolving power is a measure of the clarity of the image; it is the minimum distance two points can be separated and still be distinguished as two separate points.

(Super Resolved Fluorescence Microscopy)

- (p.111) 4. In *cell fractionation*, whole cells are broken up in a blender, and this slurry is centrifuged several times. Each time, smaller and smaller cell parts are isolated. This will isolate different organelles and allow study of their biochemical activities. According to Figure 7.3:

- which organelles are the largest ones isolated in this procedure? nuclei - mitochondria - chloroplasts
- which organelles are the smallest ones isolated in this procedure? ribosomes - plasma membranes

- (p.112) 5. Which two domains consist of **prokaryotic cells**? Archaea Bacteria

- (p.112)6. A major difference between ^{"kernel" = nucleus}prokaryotic and ^{"kernel" = nucleus}eukaryotic cells is the location of their DNA. Describe this difference. ^{"before"} ^{"true"}

Prokaryotic cells do NOT have any membrane-bound organelles including a nucleus. Their DNA is concentrated in a region called the nucleoid. Some bacteria have a circular ring of DNA called a plasmid.

Eukaryotic DNA is organized into structures called chromosomes located in a membrane-bound organelle called a nucleus.

- (p.112)7. On the sketch of a prokaryotic cell to the right, label each of these structures below and give the MAIN function of each. (Figure 7.4)

cell wall - rigid structure that provides structure, shape and protection

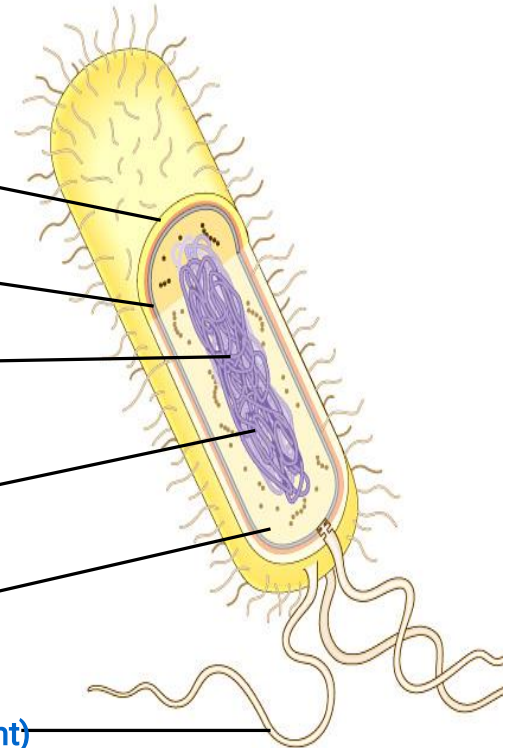
plasma membrane - encloses the cytoplasm and controls what goes in and out of the cell

bacterial chromosome - organizes the DNA

nucleoid - region where most of the cell's DNA is located.

cytoplasm - semifluid substance (gel-like) that contains the cellular structures. (cytosol)

flagella - tail-like structure used in locomotion (movement)

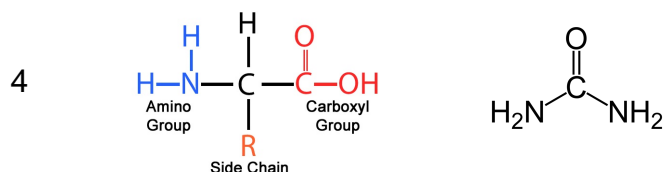


- (p.112-113)8. Why are cells so small or microscopic? Explain the relationship of surface area to volume.

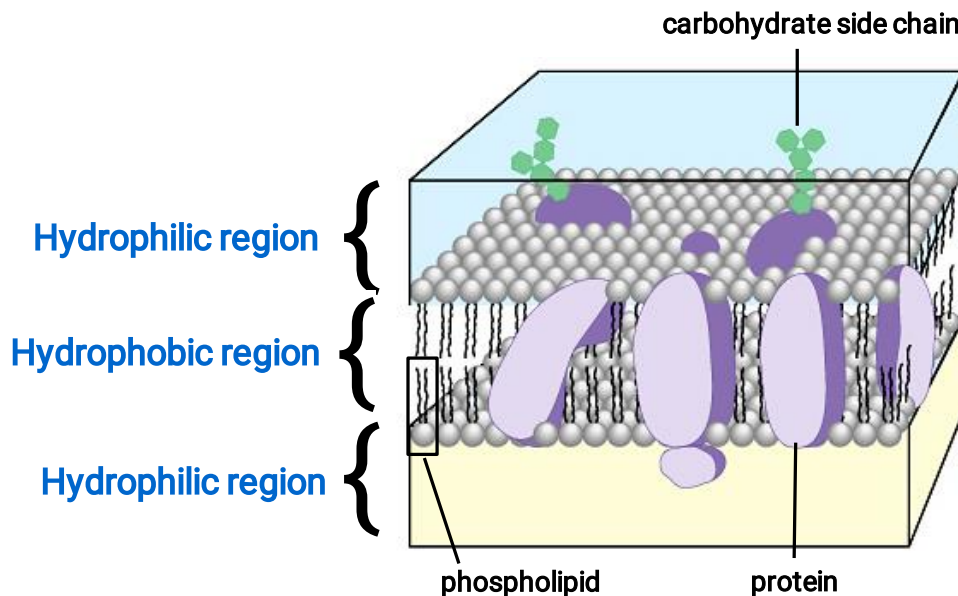
Cells are small (microscopic) in order to have a surface area (plasma membrane) sufficiently large enough to accommodate the volume (cytoplasm). A high surface area to volume ratio facilitates the exchange of materials between the cell and its environment.

Exchange of Materials = $C_6H_{12}O_6$ and O_2 - IN / CO_2 , H_2O and nitrogenous wastes - OUT

(proteins \rightarrow amino acids \rightarrow $-NH_3$ \rightarrow urea \rightarrow urine)

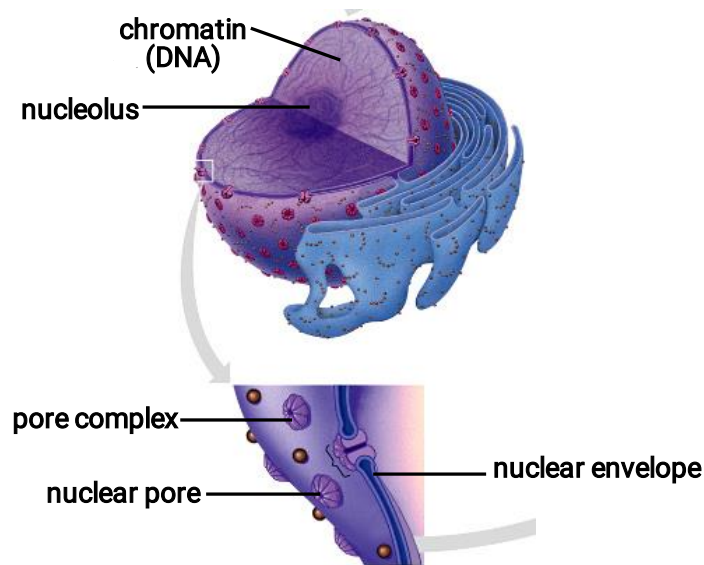


- (p.113)9. Plasma membranes of various kinds are fundamental to the organization of the cell. Their structure dictates their function. Label the basic structure of a plasma membrane below. (Figure 7.6)



- (p.116)10. In the figure to the right, label the *nuclear envelope*, *nuclear pores*, *pore complex*, *nucleolus* and *chromatin*. What is the *Nuclear matrix*? (Figure 7.9)

The nuclear matrix is a framework of fibers extending throughout the nuclear interior.



- (p.116)11. Describe the nuclear envelope. How many layers is it?

The nuclear envelope consists of two membranes separated by a narrow space perforated with pores.

- (p.116)12. Found within the nucleus are the *chromosomes*. They are made of *chromatin*. What are the two components of chromatin? When do the thin chromatin fibers condense to become distinct chromosomes?

The two components of chromatin are proteins (histones) and DNA. Thin chromatin fibers condense into chromosomes when a cell prepares to divide (mitosis).

- (p.117)13. When are the *nucleoli* visible and what is assembled here?

Nucleoli are visible in a nondividing nucleus and the main components of ribosomes are assembled here.

- (p.117)14. What is the function of *ribosomes*? Where are they located in a cell? What are their two components?

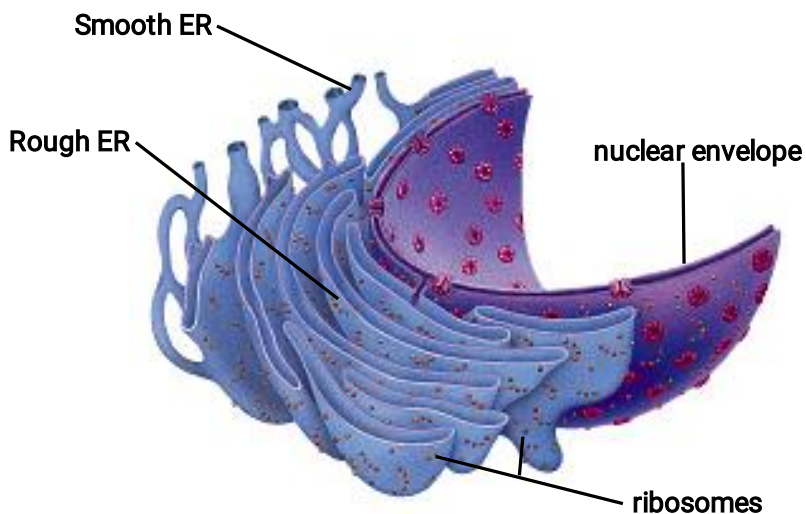
Ribosomes function in protein synthesis. Ribosomes are located freely in the cytoplasm or attached onto endoplasmic reticulum (ER) forming rough ER. The two components of a ribosome are large and small subunit.

- (p.118)15. List all the structures of the endomembrane system.

The structures of the endomembrane system include the nuclear envelope, ER, Golgi apparatus, lysosomes, various kinds of vacuoles, and the plasma membrane.

- (p.118-119)16. The *endoplasmic reticulum (ER)* makes up more than half the total membrane system in many eukaryotic cells. Label the diagram below and use it to explain the difference between *smooth* and *rough ER*. (Figure 7.11)

Smooth ER do NOT contain ribosomes and Rough ER do contain ribosomes that stud the cytoplasmic side of the ER membrane.



- (p.118)17. List and describe three major functions of the smooth ER.

The three major function of the smooth ER are:

- (1) synthesis of lipids including steroid hormones like estrogen and testosterone**
- (2) metabolism of carbohydrates (glucose \longrightarrow glycogen / glycogen \longrightarrow glucose)**
- (3) detoxification of drugs and poisons**

- (p.118)18. Why does alcohol abuse increase tolerance to other drugs such as barbiturates?

Alcohol abuse increases the tolerance to other drugs such as barbiturates because it induces the proliferation of Smooth ER and its detoxifying enzyme which, in turn, increase a person's tolerance requiring a higher dose to achieve a particular effect.

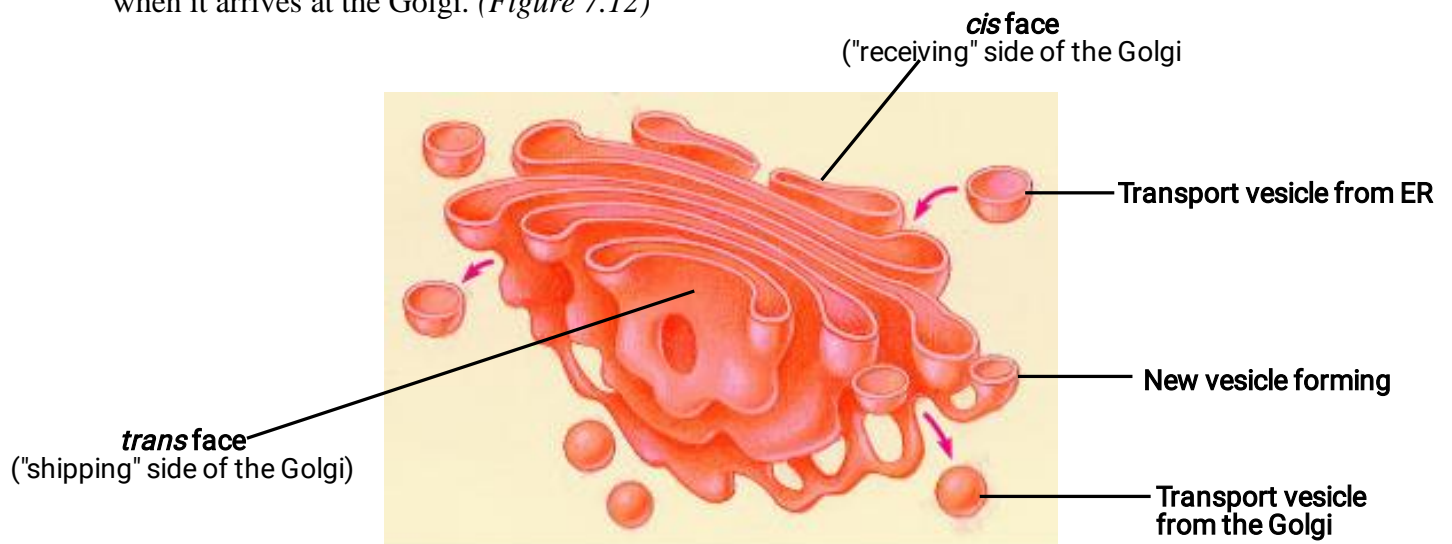
- (p.119)19. The rough ER is studded with ribosomes. As proteins are synthesized, they are threaded into the lumen of the rough ER. Some of these proteins have carbohydrates attached to them in the ER to form *glycoproteins*. What does the ER then do with these secretory proteins?

Once secretory proteins are formed, the ER membrane keeps them separate from the proteins, produced by free ribosomes, that will remain in the cytosol (cytoplasm). These secretory proteins depart from the ER wrapped in the membrane of the vesicles that bud like bubbles from the ER. Such vesicles in transit from one part of the cell to another are called transport vesicles.

- (p.119) 20. Besides packaging secretory proteins into transport vesicles, what is another major function of the rough ER?

Another major function of rough ER is to synthesis more plasma membranes by adding proteins to phospholipids.

- (p.120) 21. The transport vesicles formed from the rough ER fuse with the Golgi apparatus. Label the diagram below and use it to describe what happens to a transport vesicle and its contents when it arrives at the Golgi. (Figure 7.12)

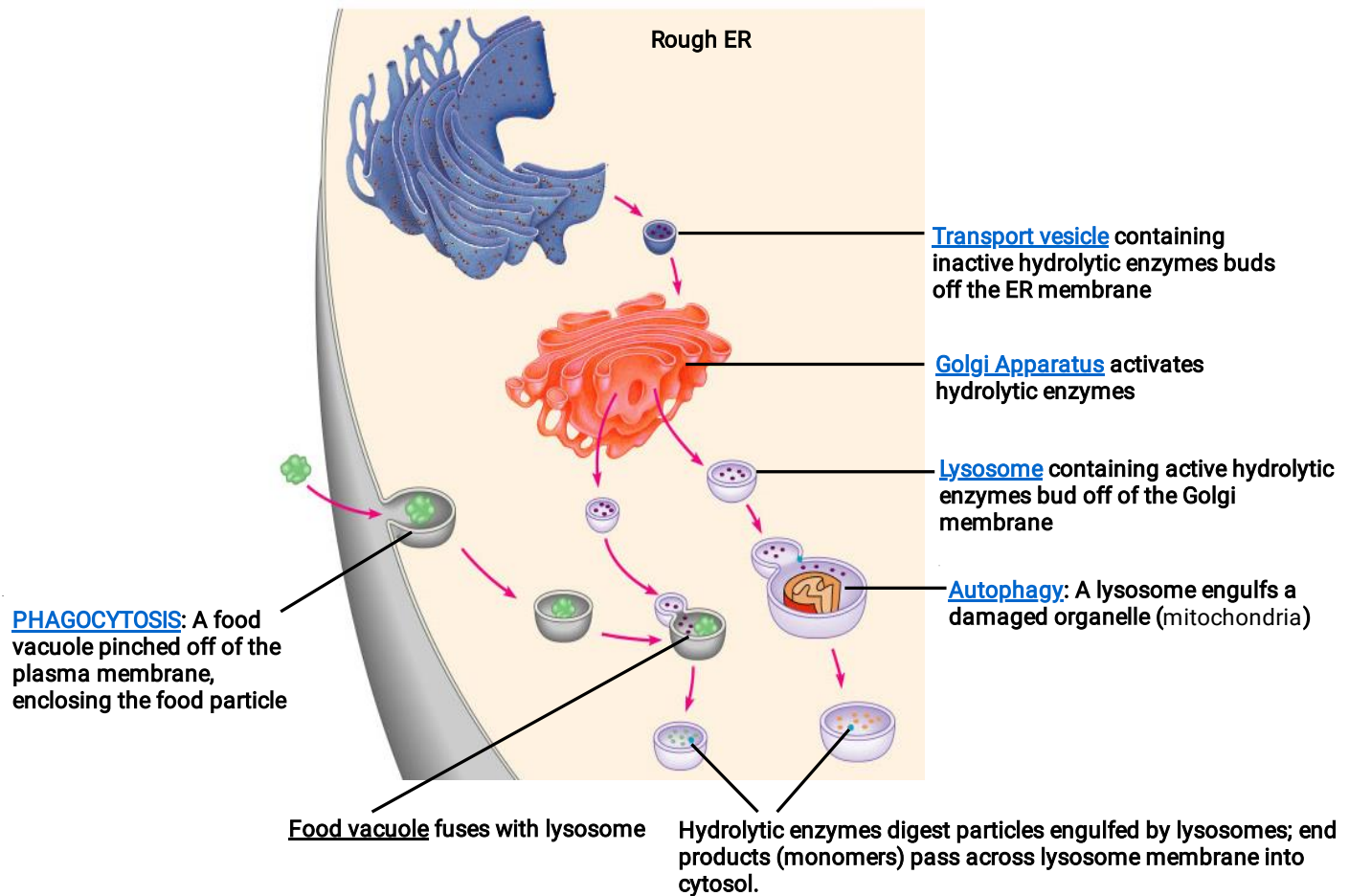


When it arrives at the Golgi Apparatus, the transport vesicle fuses with the *cis* face of the Golgi releasing its contents (proteins) that are modified and temporarily stored until released from the trans face of the Golgi Apparatus.

- (p.121)22. What is a *lysosome*? What do they contain? What is their pH?

A lysosome is a membrane-bound sac of hydrolytic enzymes that the cell uses to digest macromolecules. The pH of a lysosome is about a 5 (acidic).

- (p.122)23. One function of lysosomes is INTRAcellular digestion of particles engulfed by *phagocytosis*. What does the prefix intra mean? Label the diagram below and use it to describe this process of intracellular digestion. What human cells carry out phagocytosis? (Figure 7.14) **2016 Noble Prize**



- (p.122)24. Two genetic diseases we will be studying this year are Adrenoleukodystrophy (ALD) and Tay-Sachs disease. What happens in Tay-Sachs disease and explain the role lysosomes play in this genetic disorder.

In Tay-Sachs disease a lipid-digesting enzyme located in the lysosome is missing or inactive (*B*-hexsoaminidase), the brain becomes impaired by an accumulation of fats/lipids in the brain.

(p.123)25. There are three main types of vacuoles. Briefly describe each by giving at least 3 functions/materials store there.

food vacuoles - **formed by phagocytosis and contained food particles**

contractile vacuoles - **found in many freshwater protists (single-celled organisms) and pumps excess water out of the cell**

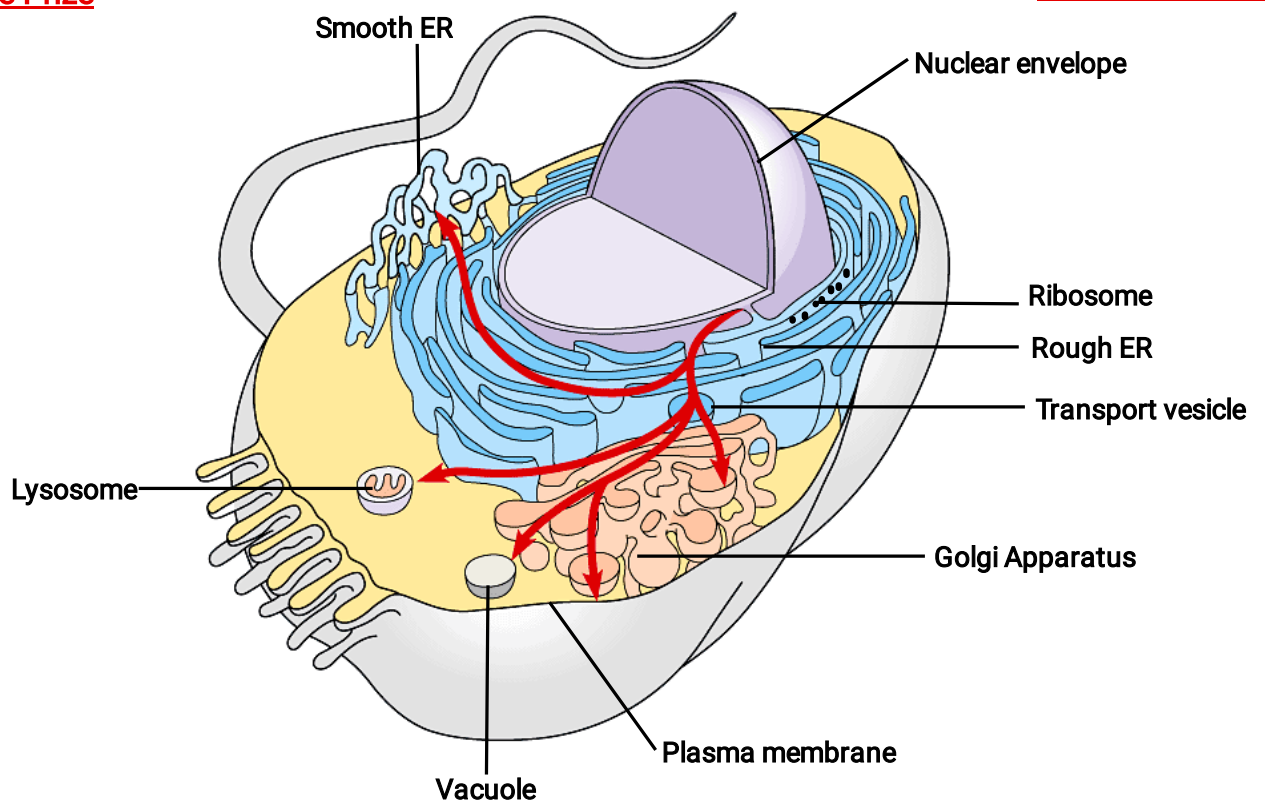
central vacuoles in plants - **usually the largest compartment in plant cells and functions in the storage of cell sap, proteins, K^+ and Cl^- .**

(p.119,123)26. Label the diagram below and use it to explain how the elements of the endomembrane system function together to secrete a protein and to digest a cellular component. (Figure 7.16)

(See #23)

2013 Noble Prize

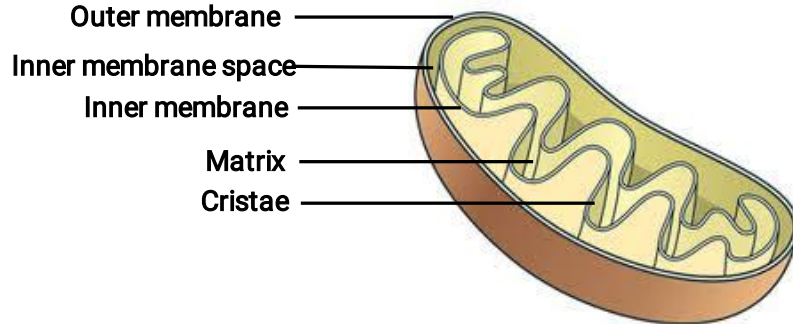
1999 Noble Prize



The red arrows show some of the pathways of membrane migration. Proteins produced by ribosomes on the rough ER enter the rough ER where protein folding takes place. Transport vesicles carry the proteins to the Golgi Apparatus where they fuse and enter the organelle. Here, the new proteins are modified and stored and exported from the cell via a transport vesicle.

2 Minute Classroom

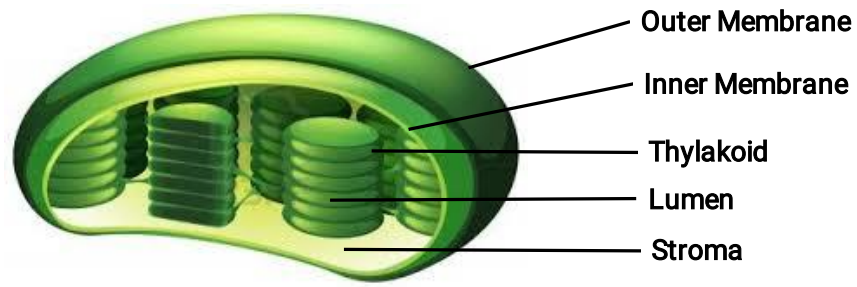
- (p.124)27. Mitochondria and chloroplasts are not considered part of the endomembrane system, although they are enclosed by membranes. Label the diagram of the mitochondria below being sure to include the *outer membrane*, *inner membrane*, *inner membrane space*, *cristae*, and *matrix*. (Figure 7.17)



- (p.124)28. What is the function of the mitochondria?

The function of the mitochondria is to carry out aerobic cellular respiration, a catabolic process that generates ATP by extracting energy from sugars.

- (p.125)29. Now label the diagram of the chloroplast below being to include the *outer membrane*, *inner membrane*, *inner membrane space*, *thylakoids*, *granum*, and *stroma*. Notice that the mitochondrion had two membrane compartments, while the chloroplast has three compartments. (Figure 7.18)



- (p.125)30. What is the function of the chloroplasts?

The function of the chloroplast is to carry out photosynthesis which converts the solar energy of the sun to chemical energy by absorbing sunlight and using it to make sugar.

31. Recall the relationship of structure to function. Why is the inner membrane of the mitochondria highly folded? What role do all the individual thylakoid membranes serve? (Same answer for both questions.)

The folds of the inner membrane of the mitochondria along with the many individual thylakoid membranes serve to INCREASE the SURFACE AREA to increase the efficiency of both biological processes crucial for LIFE.

Chloroplasts and mitochondria both have ribosomes and their own DNA. You will learn later about their evolution, but for now hold onto these facts. They are semiautonomous organelles that grow and reproduce within the cell. **DUCK IT!**

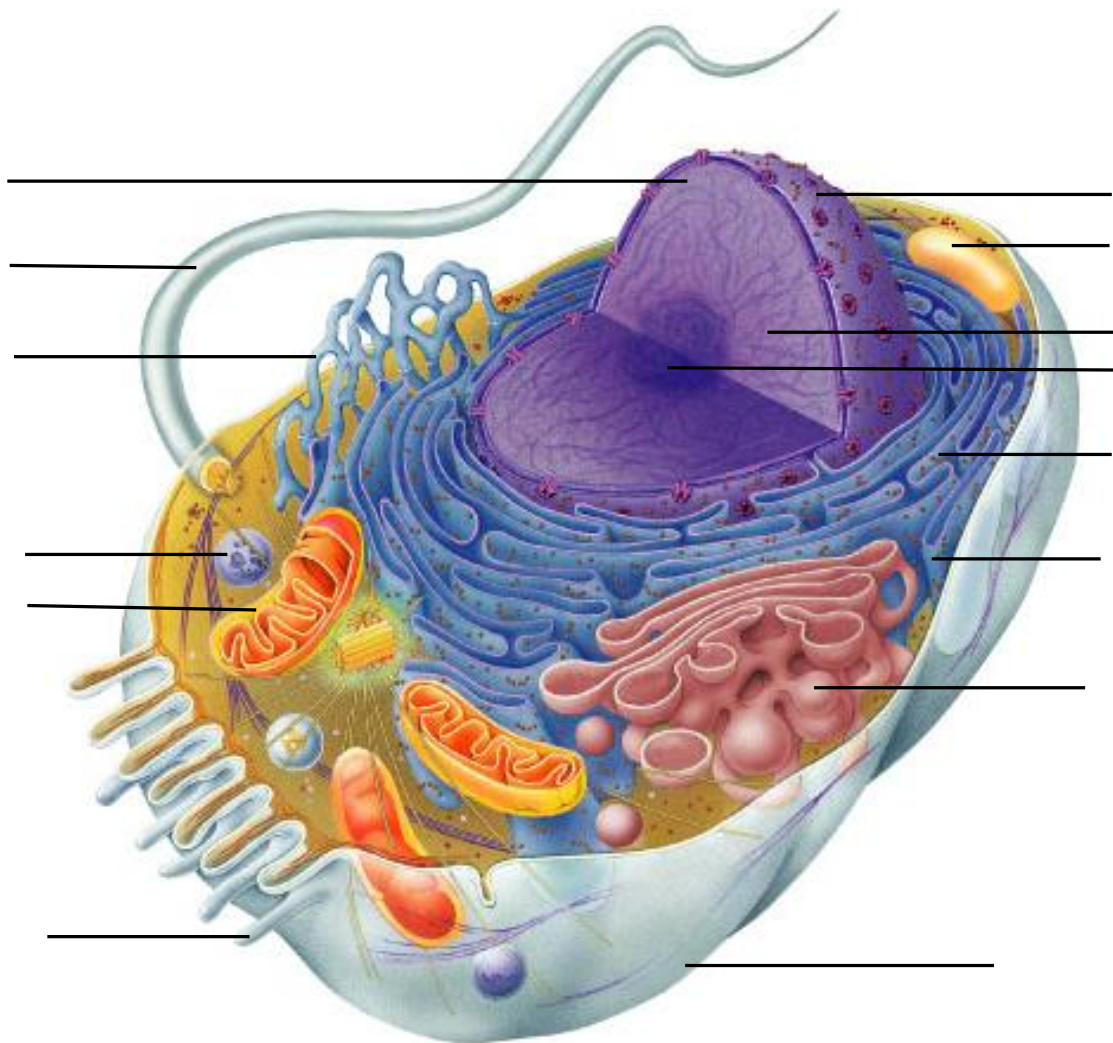
(Nucleus media: Cell Structure)

Animal Cell Summary

Label the diagram of the Animal Cell below.

(Figure 7.7)

<u>Structures to Label:</u>			
Nucleus	Chromatin	Nucleolus	Nuclear Envelope
Ribosomes	Golgi Appartus	Plasma Membrane	Mitochondria
Lysosome	Microvilli	Peroxisome	Centrosome
Flagellum	Rough ER	Smooth ER	Microvilli



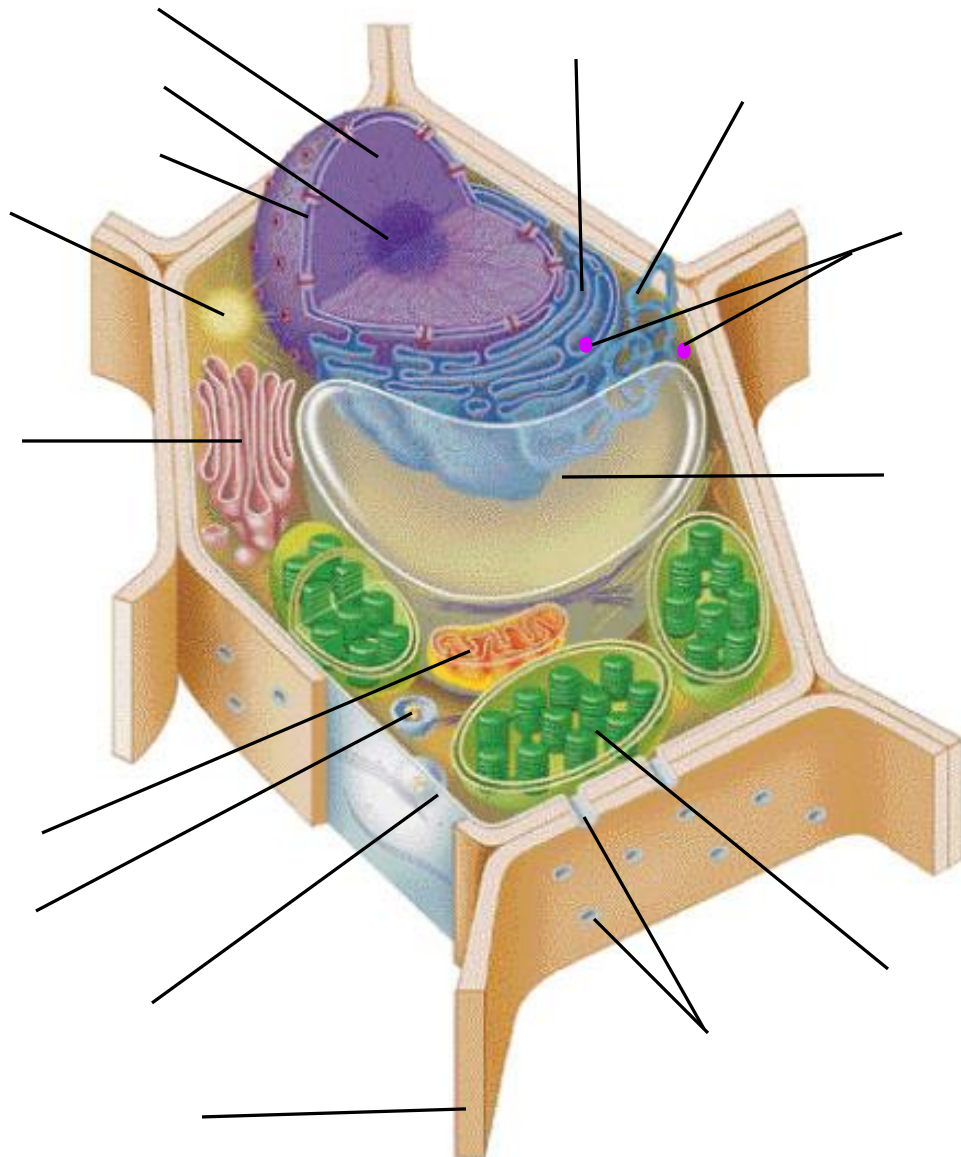
Which 4 structures are not found in Animal Cells?

Plant Cell Summary

Label the diagram of the Plant Cell below.

(Figure 7.8)

<u>Structures to Label:</u>			
Nucleus	Chromatin	Nucleolus	Nuclear Envelope
Ribosomes	Golgi Apparatus	Plasma Membrane	Mitochondria
_____	_____	Peroxisome	Centrosome
_____	Rough ER	Smooth ER	Central Vacuole
Tonoplast	Chloroplast	Plasmodesmata	Cell Wall



Which 3 structures are not found in Animal Cells?

Chapter 7 - Review Questions

- ___1) Which of the following statements about cells is *true*?
 A) All cells have cell walls. C) All cells are attached to other cells.
 B) All cells have internal structures that move. D) All cells are motile.
- ___2) Light microscopes -
 A) typically provide more resolution than an electron microscope.
 B) work by reflecting electrons off the surface of an object being studied.
 C) use light and glass lenses to magnify an image.
 D) are generally not used to view bacteria.
- ___3) One centimeter = _____ millimeters.
 A) 0.01 B) 0.10 C) 10 D) 100
- ___4) Resolution is the -
 A) ability of an optical instrument to show two close objects as separate.
 B) size of an image.
 C) ability of an optical instrument to magnify an image.
 D) distance between the lenses of a microscope.
- ___5) Which of the following statements about electron microscopes is *true*?
 A) Electron microscopes focus electron beams to create a magnified image of an object.
 B) Scanning electron microscopes are used to study the details of internal cell structure.
 C) Transmission electron microscopes are mainly used to study cell surfaces.
 D) Specimens must be sectioned to be viewed under a scanning electron microscope.
- ___6) A scientist wants to examine **living** cells lining the respiratory tract to determine how the cells use tiny hairs to move dirt and mucus away from the lungs. Which of the following instruments would be best, and why?
 A) a light microscope, because it allows observations of whole, live cells
 B) a transmission electron microscope, because it has high resolution
 C) a scanning electron microscope, because it can reveal structures on cell surfaces
 D) a scanning electron microscope, because it can be used to observe whole cells without slicing them
- ___7) A scanning electron microscope is used to study _____, whereas a transmission electron microscope is used to study _____.
 A) live cells . . . dead cells C) dead cells . . . live cells
 B) cell surfaces . . . internal cell structures D) internal cell structures . . . cell surfaces
- ___8) The diameter of most animal and plant cells ranges from -
 A) 0.1 to 1.0 micrometers. C) 10 to 100 micrometers.
 B) 1.0 to 10 micrometers. D) 100 to 1000 micrometers.
- ___9) As cell size increases, the -
 A) volume and surface area decrease. C) surface area increases faster than the volume.
 B) volume increases faster than the surface area. D) surface area and volume increase at the same rate.
- ___10) Which of the following cells has the greatest surface-to-volume ratio?
 A) bacterium B) human red blood cell C) human muscle cell D) ostrich egg

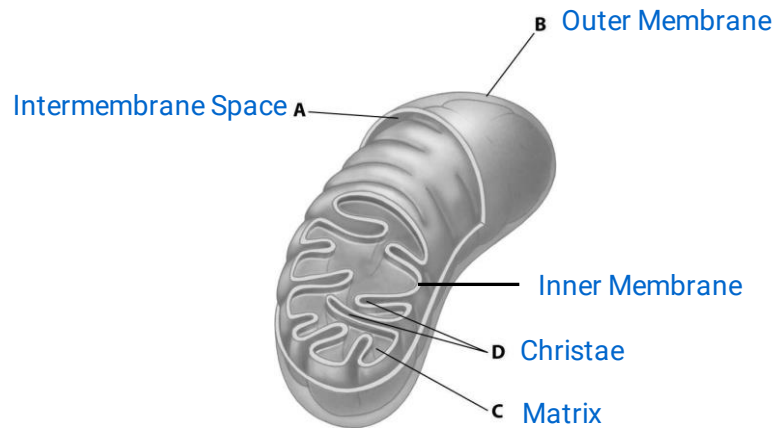
- ___11) A cell is exposed to a substance that prevents it from dividing. The cell becomes larger and larger. This situation -
 A) should present no problem to the cell, since it can continue to perform all other necessary functions.
 B) should present no problem to the cell, because the surface area of the cell will increase as the volume of the cell increases.
 C) will eventually be problematic, since the cell's ability to absorb nutrients through its outer membrane will not keep increasing as quickly as its cytoplasmic needs.
 D) should be beneficial, since the cell will be able to divert the ATP normally used for cell division to other processes.
- ___12) Your throat is dry, and you want the last cough drop in the box to last a long time in your mouth. What should you do?
 A) Break the cough drop into little pieces and put them all in your mouth. Since each little piece must be dissolved separately, the drop will last longer.
 B) Keep the cough drop whole. This maintains the largest surface-to-volume ratio, and slows the dissolution of the cough drop.
 C) Break the cough drop into little pieces and put them all in your mouth. This decreases the surface-to-volume ratio, and slows the dissolution of the cough drop.
 D) It doesn't matter if the cough drop is in one piece or many pieces; the total amount of cough drop is all that matters.
- ___13) In the plasma membrane, the phospholipid heads -
 A) are hydrophilic and face outward towards the aqueous solution on both sides of the membrane
 B) are hydrophilic and face inward, shielded from water
 C) are hydrophobic and face outward towards the aqueous solution on both sides of the membrane
 D) are hydrophobic and face inward, shielded from water
- ___14) Archaea are composed of _____ cells.
 A) prokaryotic B) bacterial C) eukaryotic D) animal
- ___15) Which of the following structures is exclusively associated with prokaryotic cells?
 A) a membrane-bound nucleus C) chromosome
 B) nucleoid D) ribosomes
- ___16) The nucleoid region of a prokaryotic cell -
 A) contains the cell's DNA. C) is surrounded by a nucleoid membrane.
 B) separates the RNA from the cytoplasm. D) contains the cell's nucleoli.
- ___17) _____ cells lack a membrane-enclosed nucleus.
 A) Plant B) Prokaryotic C) Eukaryotic D) Fungal
- ___18) A bacterial cell's DNA is found in its -
 A) ribosomes. B) nucleus. C) nucleoid region D) capsule.
- ___19) You are told that the cells on a microscope slide are plant, animal, or bacterial. You look at them through a microscope and see cell walls and membrane-bound organelles. You conclude correctly that the cells -
 A) are plant cells. C) are bacterial cells.
 B) are animal cells. D) could be either plant or bacterial cells.
- ___20) Unlike animal cells, plant cells have _____ and _____. Unlike plant cells, animal cells have _____.
 A) chloroplasts . . . cell walls . . . centrioles C) chloroplasts . . . cell walls . . . a nucleus
 B) centrioles . . . chloroplasts . . . cell walls D) centrioles . . . cell walls . . . large central vacuoles
- ___21) The nucleus of a cell -
 A) is surrounded by a single layer of membrane. C) contains DNA.
 B) is contained within the nucleolus. D) is the primary location of protein synthesis.

- ___22) The complex of proteins and DNA in a nondividing cell is called -
 A) chromatin. C) a ribosome.
 B) a nucleolus. D) a lysosome.
- ___23) During cell reproduction, chromatin coils up into structures called -
 A) ribosomes. C) chromosomes.
 B) lysosomes. D) nucleoli.
- ___24) The function of the nucleolus is -
 A) to manufacture polypeptides. C) intracellular digestion.
 B) to manufacture ribosomal RNA. D) to store chromatin.
- ___25) Protein synthesis requires the use of mRNA, which -
 A) is made in the nucleolus.
 B) must be made by the ribosomes.
 C) is translated by the ribosomes into the amino acid sequences of proteins.
 D) carries the message to the nucleus to synthesize new DNA during cell division.
- ___26) Which of the following statements regarding the endomembrane system is *false*?
 A) The endomembrane system is involved in the synthesis, storage, and export of important molecules.
 B) The endomembrane system includes the rough and smooth endoplasmic reticulum.
 C) The endomembrane system includes the nuclear envelope.
 D) The endomembrane system is a system of interrelated membranes that are all physically connected.
- ___27) The endomembrane system includes all of the following organelles *except* the -
 A) plasma membrane. C) peroxisome.
 B) endoplasmic reticulum. D) Golgi apparatus.
- ___28) Smooth endoplasmic reticulum -
 A) stores calcium ions in muscle cells.
 B) is the major site of carbohydrate synthesis in eukaryotic cells.
 C) produces proteins for cell membranes.
 D) helps assemble ribosomes for protein synthesis.
- ___29) The two main functions of the rough endoplasmic reticulum are the production of -
 A) mitochondria and proteins secreted by the cell.
 B) hydrogen peroxide and steroid hormones secreted by the cell.
 C) ribosomes and steroid hormones.
 D) membrane and proteins secreted by the cell.
- ___30) Secretory proteins are -
 A) produced by ribosomes on the smooth endoplasmic reticulum.
 B) chemically modified in the nucleus.
 C) produced by the cell for internal use.
 D) released from the cell through the plasma membrane.
- ___31) The cells that produce hair contain a lot of _____, while the cells that produce the lipids and oils that coat the hair contain a lot of _____.
 A) smooth endoplasmic reticulum . . . lysosomes
 B) rough endoplasmic reticulum . . . smooth endoplasmic reticulum
 C) smooth endoplasmic reticulum . . . rough endoplasmic reticulum
 D) microbodies . . . lysosomes

- ___32) The Golgi apparatus -
 A) is composed of stacks of membranous vesicles that are continuous with one another.
 B) stores, modifies, and packages proteins.
 C) strings together amino acids to produce proteins.
 D) is the site of carbohydrate breakdown.
- ___33) Which of the following statements regarding the Golgi apparatus is *false*?
 A) The Golgi apparatus works closely with the endoplasmic reticulum.
 B) The Golgi apparatus serves as a molecular warehouse and finishing factory.
 C) The Golgi apparatus decreases in size when a cell increases its protein production.
 D) The Golgi apparatus modifies chemicals received from the endoplasmic reticulum.
- ___34) Which of the following statements about lysosomes is *false*?
 A) Lysosomes help to digest worn-out or damaged organelles.
 B) Lysosomes synthesize proteins from the recycled amino acids.
 C) Lysosomes fuse with food vacuoles to expose nutrients to lysosomal enzymes.
 D) Lysosomes destroy harmful bacteria engulfed by white blood cells.
- ___35) Tay-Sachs disease results from the malfunction of -
 A) mitochondria. C) endoplasmic reticulum.
 B) lysosomes. D) nucleoli.
- ___36) Tay-Sachs disease -
 A) causes an accumulation of lipids in brain cells.
 B) involves damage to liver cells.
 C) is due to the absence of an enzyme that digests polysaccharides.
 D) prevents the breakdown of glycogen.
- ___37) Which of the following statements about the functions of a plant cell central vacuole is *false*?
 A) The central vacuole of a plant cell may help increase the size of cells by absorbing water.
 B) The central vacuole of a plant cell may store waste products.
 C) The central vacuole of a plant cell may digest chemicals for recycling.
 D) The central vacuole of a plant cell may store poisons.
- ___38) Contractile vacuoles -
 A) are generally found in protists that inhabit salt water.
 B) help in the excretion of excess salt.
 C) prevent cells from bursting as a result of the influx of excess water.
 D) allow organisms to avoid dehydration by absorbing water from the environment.
- ___39) A manufacturing company dumps its wastes into a nearby pond. One of the wastes is found to paralyze the contractile vacuoles of certain protists. A biologist looking at individual samples of these organisms taken from the pond would find that they -
 A) have lost water and shrunk.
 B) have gained water and burst.
 C) have died of malnutrition.
 D) have died because wastes have built up in the cytoplasm.
- ___40) Insulin is a protein that is produced by pancreatic cells and secreted into the bloodstream. Which of the following options correctly lists the order of the structures through which insulin passes from its production to its exit from the cell?
 A) rough ER, transport vesicles, Golgi apparatus, transport vesicles, cell membrane
 B) rough ER, lysosomes, transport vesicles, cell membrane
 C) rough ER, Golgi apparatus, smooth ER, cell membrane
 D) rough ER, transport vesicles, Golgi apparatus, vacuole, cell membrane

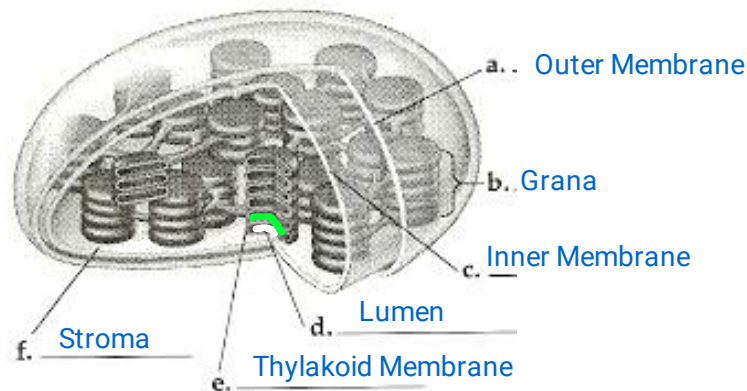
- ___41) The function of mitochondria is -
 A) cellular respiration. C) photosynthesis.
 B) lipid synthesis. D) intracellular digestion.
- ___42) Cyanide inhibits mitochondrial function; as a result, the rate of -
 A) ATP synthesis increases. C) photosynthesis increases.
 B) ATP synthesis decreases. D) protein synthesis increases.
- ___43) The _____ of a mitochondrion is/are an adaptation that increases the surface area and enhances a mitochondrion's ability to produce ATP.
 A) stroma B) intermembrane space C) cristae D) matrix
- ___44) The function of chloroplasts is -
 A) cellular respiration. C) photosynthesis.
 B) lipid synthesis. D) intracellular digestion.
- ___45) The stroma is the -
 A) thick fluid enclosed by the inner chloroplast membrane.
 B) watery fluid enclosed by the inner membrane of a mitochondrion.
 C) space between the inner and outer membranes of a chloroplast.
 D) space between the inner and outer membranes of a mitochondrion.
- ___46) Mitochondria differ from chloroplasts in that mitochondria -
 A) convert light energy from the sun to chemical energy, whereas chloroplasts convert one form of chemical energy to another.
 B) contain three different membrane-bound compartments, whereas chloroplasts contain two.
 C) contain membrane folds called cristae, whereas chloroplasts contain disk-like vesicles in stacks called grana.
 D) are not found in plants, whereas chloroplasts are not found in animals.
- ___47) The endosymbiosis hypothesis proposes that -
 A) two cells were juxtaposed and one benefited from the other.
 B) a small cell lived inside a larger cell to the benefit of both cells.
 C) a large cell engulfed and digested a smaller cell, exposing its enzymes for use by the larger cell.
 D) two cells merged into one cell, improving the enzyme function of the new cell.
- ___48) Cilia differ from flagella in that -
 A) cilia contain nine microtubule doublets surrounding a central pair of microtubules, while flagella contain only nine microtubule doublets.
 B) the protein filaments of cilia are "naked," while those of flagella are wrapped in an extension of the cell membrane.
 C) cilia are typically more numerous and shorter than flagella.
 D) cilia are anchored only in the proteins of the cell membrane, while flagella are anchored in a special structure called the basal body.
- ___49) Which of the following statements regarding plasmodesmata is *false*?
 A) Plasmodesmata penetrate plant cell walls.
 B) Plasmodesmata carry chemical messages between plant cells.
 C) Plasmodesmata carry nutrients between plant cells.
 D) Plasmodesmata are found in plants as well as some single-celled organisms.

Label the diagram of the Mitochondria below.



- ___50) Which part of the mitochondrion shown enhances its ability to produce ATP by increasing surface area?
 A) structure A B) structure B C) structure C D) structure D
- ___51) Where does the process of Glycolysis take place?
 A) structure A B) structure B C) structure C D) structure D
- ___52) Where does the Krebs Cycle take place?
 A) structure A B) structure B C) structure C D) structure D
- ___53) Where does the Electron Transport Chain take place?
 A) structure A B) structure B C) structure C D) structure D

Label the diagram of the Chloroplast below.



- ___54) Which part of the chloroplast shown enhances its ability to produce glucose by increasing surface area?
 A) structure A B) structure B C) structure D D) structure F
- ___55) Where does the Light Reaction take place?
 A) structure A B) structure B C) structure C D) structure E
- ___56) Where does the Calvin Cycle take place?
 A) structure C B) structure D C) structure E D) structure F
- ___57) Where does the Electron Transport Chain take place?
 A) structure A B) structure C C) structure E D) structure F