Name_____Period_____

Chapter 6: A Tour of the Cell

Concept 6.1 To study cells, biologists use microscopes and the tools of biochemistry

1. The study of cells has been limited by their small size, and so they were not seen and described until 1665, when Robert Hooke first looked at dead cells from an oak tree. His contemporary, Anton van Leeuwenhoek, crafted lenses; and with the improvements in optical aids, a new world was opened. *Magnification* and *resolving power* limit what can be seen. Explain the difference.

2. The development of electron microscopes has further opened our window on the cell and its organelles. What is considered a major disadvantage of the electron microscopes?

3. Study the electron micrographs in your text. Describe the different types of images obtained from:

   scanning electron microscopy (SEM)

   transmission electron microscopy (TEM)

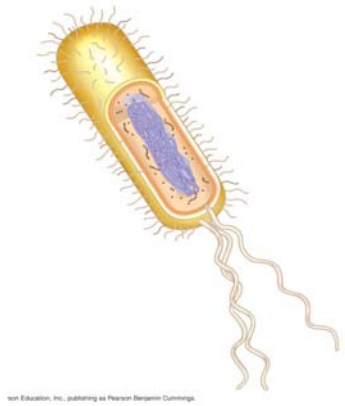
4. In *cell fractionation*, whole cells are broken up in a blender, and this slurry is centrifuged several times. Each time, smaller and smaller cell parts are isolated. This will isolate different organelles and allow study of their biochemical activities. Which organelles are the smallest ones isolated in this procedure?

Concept 6.2 Eukaryotic cells have internal membranes that compartmentalize their functions

5. Which two domains consist of prokaryotic cells?

6. A major difference between prokaryotic and eukaryotic cells is the location of their DNA. Describe this difference.

7. On the sketch of a prokaryotic cell, label each of these features and give its function or description.



cell wall

plasma membrane

bacterial chromosome

nucleoid

cytoplasm

flagella

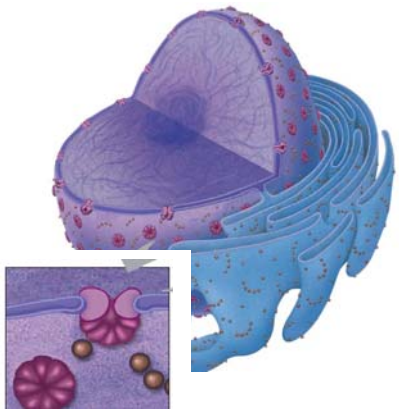
8. Why are cells so small? Explain the relationship of surface area to volume.

9. Describe how many neurons and intestinal cells each have greatly increased surface area.

Concept 6.3 The eukaryotic cell's genetic instructions are housed in the nucleus and carried out by the ribosomes

10. In the figure below, label the nuclear envelope, nuclear pores, and pore complex.

11. Describe the nuclear envelope. How many layers is it? What connects the layers?



12. What is the *nuclear lamina*? *Nuclear matrix*?

13. 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?

14. When are the *nucleoli* visible? What are assembled here?

15. What is the function of *ribosomes*? What are their two components?

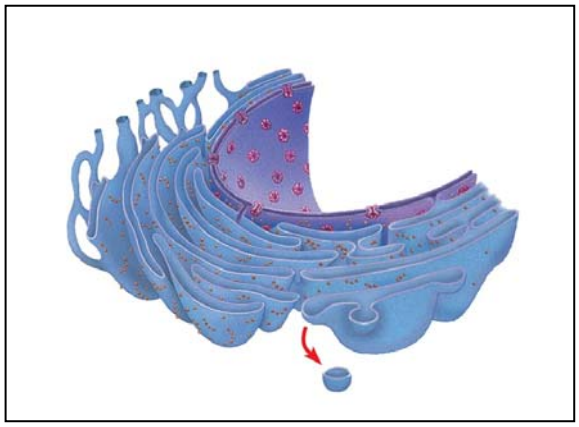
16. Ribosomes in any type of organism are all the same, but we distinguish between two types of ribosomes based on where they are found and the destination of the protein product made. Complete this chart to demonstrate this concept.

Type of Ribosome	**Location**	**Product**
Free ribosomes		
Bound ribosomes		

Concept 6.4 The endomembrane system regulates protein traffic and performs metabolic functions in the cell

17. List all the structures of the endomembrane system.

18. The *endoplasmic reticulum (ER)* makes up more than half the total membrane system in many eukaryotic cells. Use this sketch to explain the *lumen*, *transport vesicles*, and the difference between *smooth* and *rough ER*.



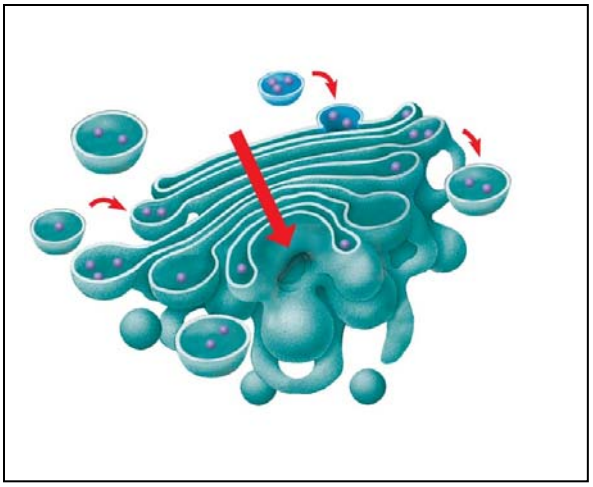
19. List and describe three major functions of the smooth ER.

20. Why does alcohol abuse increase tolerance to other drugs such as barbiturates?

21. 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?

22. Besides packaging secretory proteins into transport vesicles, what is another major function of the rough ER?

23. The transport vesicles formed from the rough ER fuse with the Golgi apparatus. Use this sketch to label the *cisterna* of the Golgi apparatus, and its *cis* and *trans* faces. Describe what happens to a transport vesicle and its contents when it arrives at the Golgi.



24. What is a *lysosome*? What do they contain? What is their pH?

25. One function of lysosomes is intracellular digestion of particles engulfed by *phagocytosis*. Describe this process of digestion. What human cells carry out phagocytosis?

26. A second function of lysosomes is to recycle cellular components in a process called *autophagy*. Describe this process.

27. What happens in Tay-Sachs disease? Explain the role of the lysosomes in Tay-Sachs.

28. There are many types of vacuoles. Briefly describe:

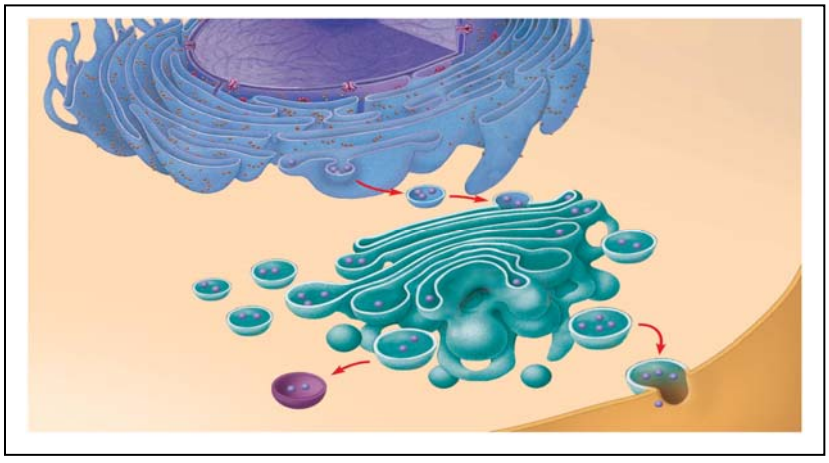
    food vacuoles

    contractile vacuoles

    central vacuoles in plants

    (give at least three functions/materials stored here)

29. Use this figure to explain how the elements of the endomembrane system function together to secrete a protein and to digest a cellular component. Label as you explain.



Concept 6.5 Mitochondria and chloroplasts change energy from one form to another

30. Mitochondria and chloroplasts are not considered part of the endomembrane system, although they are enclosed by membranes. Sketch a mitochondrion here and label its *outer membrane*, *inner membrane*, *inner membrane space*, *cristae*, *matrix*, and *ribosomes*.

31. Now sketch a chloroplast and label its *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.

32. What is the function of the mitochondria?

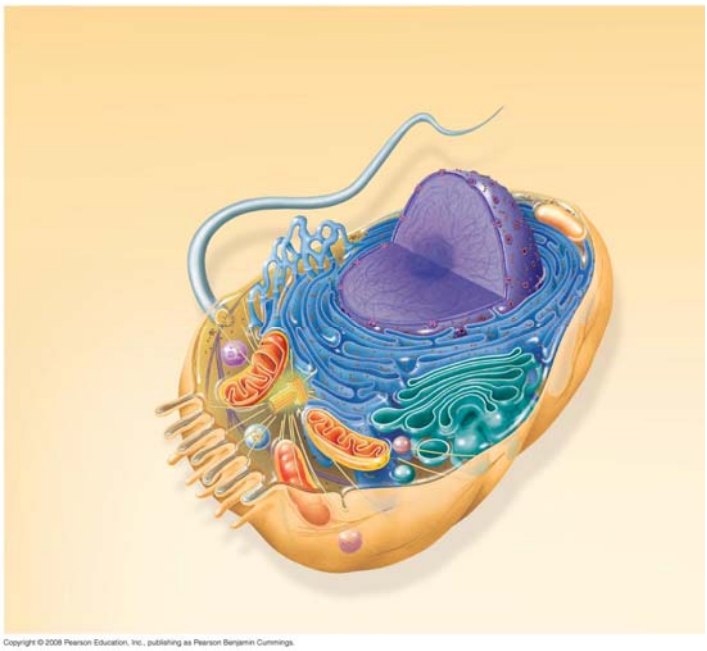
33. What is the function of the chloroplasts?

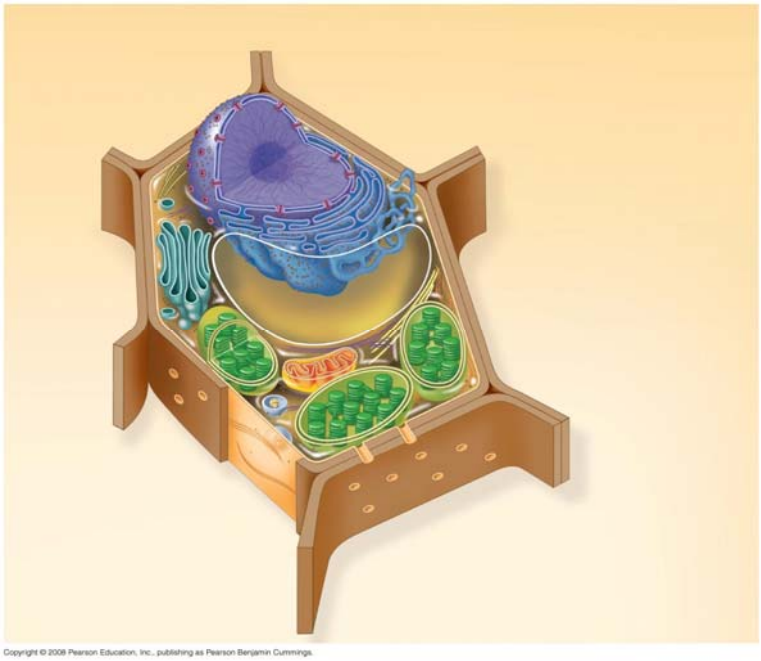
34. Recall the relationship of structure to function. Why is the inner membrane of the mitochondria highly folded? What role do all the individual thylakoid membranes serve? (Same answer for both questions.) Chloroplasts and mitochondria both have ribosomes and their own DNA. You will learn later about their evolution, but for now hold onto these facts. They are semiautonomous organelles that grow and reproduce within the cell. And you're lucky today—there is not a question here!

35. Explain the important role played by *peroxisomes*.

SUMMARY

On these diagrams of plant and animal cells, label *each* organelle and give a brief statement of its function.





Concept 6.6 The cytoskeleton is a network of fibers that organizes structures and activities in the cell

36. What is the *cytoskeleton*?

37. What are the three roles of the cytoskeleton?

38. There are three main types of fibers that make up the cytoskeleton. Name them.

39. *Microtubules* are hollow rods made of a globular protein called tubulin. Each tubulin protein is a dimer made of two subunits. These are easily assembled and disassembled. What are four functions of microtubules?

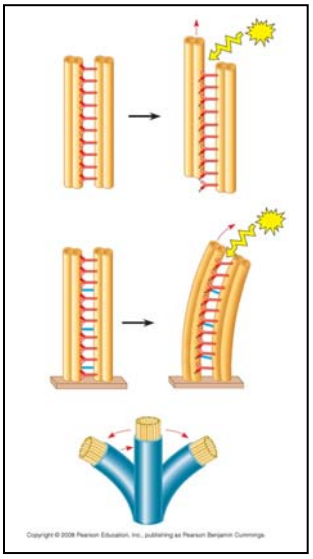
40. Animal cells have a *centrosome* that contains a pair of *centrioles*. Plant cells do not have centrioles. What is another name for centrosomes? What is believed to be the role of centrioles?

41. Describe the organization of microtubules in a centriole. Make a sketch here that shows this arrangement in cross section.

42. *Cilia* and *flagella* are also composed of microtubules. The arrangement of microtubules is said to be "9 + 2." Make a sketch of a cross section here.

43. *Compare and contrast* cilia and flagella. (This is a specific instruction that means you are to tell how they are alike—compare—and tell how they are different—contrast. Remember this hint when you see a similar phrase on an exam.)

44. How do motor proteins called *dyneins* cause movement of cilia? What is the role of ATP in this movement? This figure might help you explain.



45. *Microfilaments* are solid, and they are built from a double chain of *actin*. What are four functions of microfilaments? What are the motor proteins that move the microfilaments?

46. *Intermediate filaments* are bigger than microfilaments but smaller than microtubules. They are more permanent fixtures of cells. Give two functions of intermediate filaments.

Concept 6.7 Extracellular components and connections between cells help coordinate cellular activities

47 What are three functions of the *cell wall*?

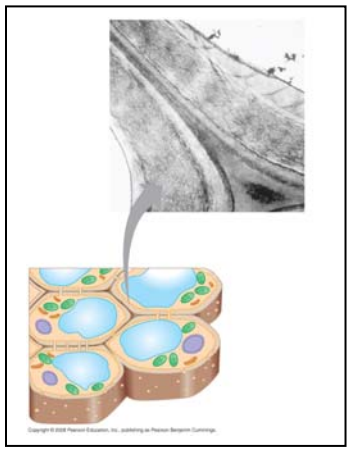
48. What is the composition of the cell wall?

49. What is the relatively thin and flexible wall secreted first by a plant cell?

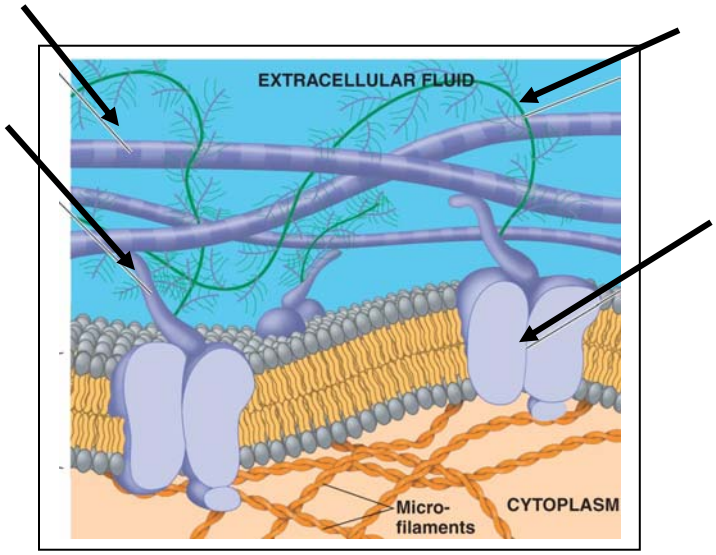
50. What is the *middle lamella*? Where is it found? What material is it made of?

51. Explain the deposition of a *secondary cell wall*.

52. On the sketch, label the *primary cell wall*, *secondary cell wall*, *middle lamella*, *cytosol*, *plasma membrane*, *central vacuole*, and *plasmodesmata*.

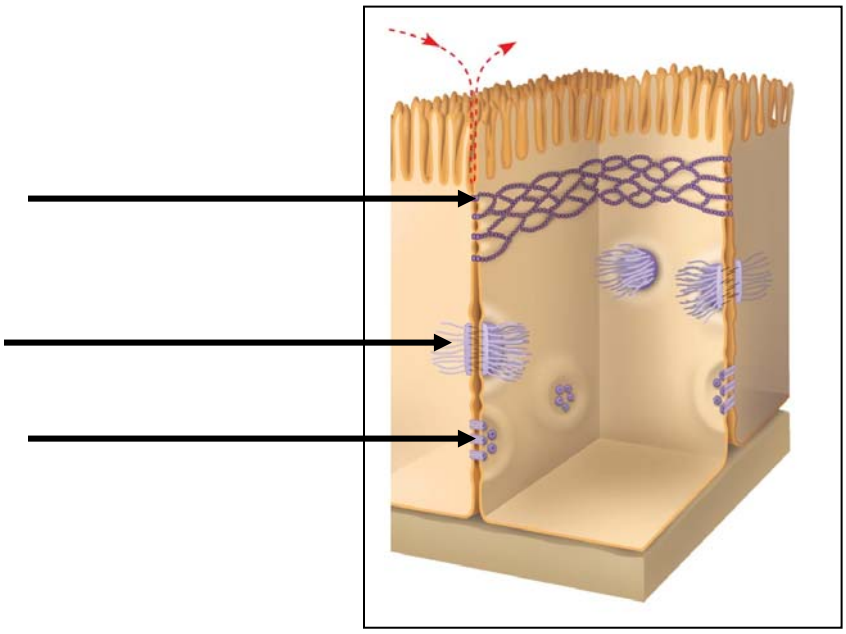


53. Animal cells do not have cell walls, but they do have an extracellular matrix (ECM). On this figure, label the elements indicated, and give the role of each.

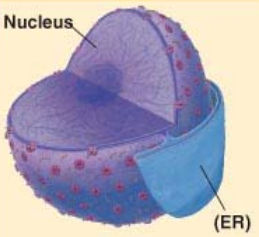
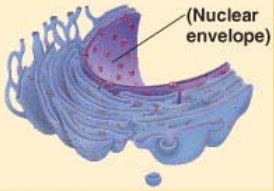


54. What are the intercellular junctions between plant cells? What can pass through them?

55. Animals cells do not have *plasmodesmata*. This figure shows the three types of intercellular junctions seen in animal cells. Label each type and summarize its role.



Here's a great chart to summarize three concepts—study it!

	Cell Component	Structure	Function
Concept 6.3 The eukaryotic cell's genetic instructions are housed in the nucleus and carried out by the ribosomes	Nucleus 	Surrounded by nuclear envelope (double membrane) perforated by nuclear pores. The nuclear envelope is continuous with the endoplasmic reticulum (ER).	Houses chromosomes, made of chromatin (DNA, the genetic material, and proteins); contains nucleoli, where ribosomal subunits are made. Pores regulate entry and exit of materials.
	Ribosome 	Two subunits made of ribosomal RNA and proteins; can be free in cytosol or bound to ER	Protein synthesis
Concept 6.4 The endomembrane system regulates protein traffic and performs metabolic functions in the cell	Endoplasmic reticulum 	Extensive network of membrane-bound tubules and sacs; membrane separates lumen from cytosol; continuous with the nuclear envelope.	Smooth ER: synthesis of lipids, metabolism of carbohydrates, Ca^{2+} storage, detoxification of drugs and poisons Rough ER: Aids in synthesis of secretory and other proteins from bound ribosomes; adds carbohydrates to glycoproteins; produces new membrane
	Golgi apparatus 	Stacks of flattened membranous sacs; has polarity (*cis* and *trans* faces)	Modification of proteins, carbohydrates on proteins, and phospholipids; synthesis of many polysaccharides; sorting of Golgi products, which are then released in vesicles.
	Lysosome 	Membranous sac of hydrolytic enzymes (in animal cells)	Breakdown of ingested substances, cell macromolecules, and damaged organelles for recycling
	Vacuole 	Large membrane-bounded vesicle in plants	Digestion, storage, waste disposal, water balance, cell growth, and protection
Concept 6.5 Mitochondria and chloroplasts change energy from one form to another	Mitochondrion 	Bounded by double membrane; inner membrane has infoldings (cristae)	Cellular respiration
	Chloroplast 	Typically two membranes around fluid stroma, which contains membranous thylakoids stacked into grana (in plants)	Photosynthesis
	Peroxisome 	Specialized metabolic compartment bounded by a single membrane	Contains enzymes that transfer hydrogen to water, producing hydrogen peroxide (H_2O_2) as a by-product, which is converted to water by other enzymes in the peroxisome

Testing Your Knowledge: Self-Quiz Answers
Now you should be ready to test your knowledge. Place your answers here:

1._____

2._____

3._____

4._____

5._____

6._____

7._____

8._____