Gartner & Hiatt: Color Textbook of Histology, 3rd Edition

Test Bank

Chapter 2 – Cytoplasm

MULTIPLE CHOICE

1. The fluidity of the plasmalemma has well-established clinical significance. Which of the following molecules decreases the cell membrane fluidity?

a. glycerol
b. phosphate group
c. cholesterol
d. integral proteins
e. peripheral proteins

Explanation:
The answer is c. Cholesterol decreases membrane fluidity. The polar heads of phospholipids molecules are composed of glycerol, to which a positively charged nitrogenous group is attached by a negatively charged phosphate group. Unsaturated fatty acyl molecules increase membrane fluidity. Integral and peripheral proteins do not have an effect on membrane fluidity.

2. A patient suffering from asthma has difficulty breathing and is treated with albuterol, a drug that relaxes bronchiolar smooth muscles. Albuterol acts as a(n)

a. cholinergic receptor antagonist
b. cholinergic receptor antagonist
c. adrenergic receptor antagonist
d. adrenergic receptor agonist
e. inhibitor of kinase phosphorylases

Explanation:
The answer is d. Albuterol is an agonist that acts on β_2-adrenergic receptors that are located mainly on the cell membranes of bronchial tissues and, therefore, do not have many side effects. If it were an antagonist, then it would cause smooth muscle constriction.

3. A patient suffering from asthma has difficulty breathing and is treated with albuterol and ipratropium, drugs that relax bronchiolar smooth muscles. Ipratropium acts as a(n)

a. cholinergic receptor antagonist
b. cholinergic receptor antagonist
c. adrenergic receptor antagonist
d. adrenergic receptor agonist

e. inhibitor of kinase phosphorylases

Explanation:
The answer is a. Ipratropium is a cholinergic receptor antagonist and interferes with the binding of acetylcholine, a neurotransmitter, to its receptor sites on the cell membrane, thus preventing the contraction of bronchiolar smooth muscle. The two drugs are used in combination agonist-antagonist therapy to have the desired effect of maintaining an open airway.

4. A 9-month-old female Jewish baby, whose parents were born in Poland, is seen by her pediatrician because of neurologic problems, including generalized paralysis and blindness. The pediatrician should suspect that the child is suffering from

a. spina bifida
b. cranial nerve X (vagus nerve) disorder
c. Tay-Sachs disease
d. Fabry's disease
e. Refsum's disease

Explanation:
The answer is c. Tay-Sachs disease affects mostly children of Eastern European Jewish ancestry as well as certain families in Lousiana of Cajun ancestry. Children suffering from this lysosomal-storage disease cannot catabolize GM_2 gangliosides that accumulate in their lysosomes, and the enlarged lysosomes interfere with cell function. The interference is most problematic in the neurons of the central nervous system and causes death by the third year of life. Neither spina bifida nor vagus nerve disorders would cause generalized paralysis or blindness. Fabry's disease, although a lysosomal-storage disorder, is due to an X chromosomal defect and affects only males. Refsum's disease is due to the accumulation of phytanic acid, a by-product of chlorophyll metabolism, and affects older children who already eat fresh fruits and vegetables.

5. Acid hydrolases are synthesized on the rough endoplasmic reticulum and are delivered to the Golgi complex to be packaged and distributed to their final destination. In patients whose protooncogenes have mutated to form ras protein–related products known as ADP-ribosylation factor (ARF), this factor may interfere with

a. coatomer II (COP II) synthesis
b. coatomer II (COP II) assembly
c. coatomer II (COP II) dissociation from vesicles
d. clathrin synthesis
e. clathrin assembly

Explanation:
The answer is b. Delivery of proteins manufactured on the rough endoplasmic reticulum to the Golgi complex is accomplished in COP-II coated vesicles. ARF catalyzes the

assembly of COP-II molecules to form coatomer on the cytoplasmic aspect of these transfer vesicles. Synthesis of COP-II proteins as well as the disassembly of the coatomer are not influenced by ARF. Clathrin coats mediate the endocytotic pathway as well as the pathway that leads away from the *trans* Golgi network.

6. Patients with sickle cell anemia possess hemoglobin-s, a mutated form of hemoglobin. Hemoglobin-s is

a. synthesized on free ribosomes
b. synthesized on the rough endoplasmic reticulum
c. modified in the Golgi apparatus
d. packaged in the *trans* Golgi network
e. stored in condensing vesicles

Explanation:
The answer is a. Hemoglobin, whether normal or mutated, is present freely in the cytosol; therefore, it is synthesized on free ribosomes. Only proteins that are to be packaged are synthesized on the rough endoplasmic reticulum. Because hemoglobin is not packaged, it does not enter the Golgi apparatus.

7. A neonatal baby boy is observed to have malformed hands, feet, and skull. Additional examination displays jaundice, hepatomegaly, and hypotonic muscles with psychomotor retardation. The pediatrician diagnoses the disorder as cerebrohepatorenal syndrome (Zellweger's syndrome). This condition is due to problems with which of the following organelles?

a. mitochondria
b. lysosomes
c. early endosomes
d. late endosomes
e. peroxisomes

Explanation:
The answer is e. Children with cerebrohepatorenal syndrome die at an early age due to mutations in their peroxin genes that code for defective receptors that are unable to transfer enzymes destined for peroxisomes into these organelles. Mitochondria, lysosomes, and endosomes are not affected by this mutation.

8. A 20-year-old male seeking help from his ophthalmologist presents with deteriorating vision in both eyes, especially his central vision. The patient also evidences cardiac dysrythmia and an apparent demyelination of the optic nerve. The ophthalmologist suspects Leber's hereditary optic neuropathy, a condition caused by a point mutation that is not X-linked but is transmitted only by females. This condition is due to problems with which of the following?

a. lysosomes
b. early endosomes
c. late endosomes
d. mitochondria
e. peroxisomes

Explanation:
The answer is d. Leber's hereditary optic neuropathy is due to a point mutation on the mitochondrial DNA. Because the spermatozoon does not contribute mitochondria to the zygote, only the female can transmit this condition to her offspring. Lysosomes, peroxisomes, and early and late endosomes do not possess DNA.

9. Which of the following refers to cadherins?

a. they are peripheral proteins
b. they are associated with cell-cell adhesion
c. they are associated with adherence to the basal lamina
d. they have binding sites for heparin sulfate
e. they are associated with hemidesmosomes

Explanation:
The answer is b. Cadherins are integral proteins that are designed to assist cells to maintain contact with one another. Hemidesmosomes, heparin sulfate, and basal lamina are all associated with cell-to-extracellular matrix contact.

10. Dynein arms are always attached to one of the following. Which one is that structure?

a. central sheet
b. singlets
c. subunit A
d. subunit B
e. radial spoke

Explanation:
The answer is c. Dynein arms are microtubule-associated proteins that function in bending of the cilium. These molecular motors are attached to the subunit A of the axoneme. The central sheet and the radial spokes are both composed of an elastic protein that becomes stretched during the "cocking" of the axoneme and, as they return to their normal length, they effect ciliary motion.

11. The component of the erythrocyte cell membrane that is the most essential in maintaining its biconcave disc shape is

a. glycophorin
b. spectrin

c. ankyrin
d. actin
e. band 3 protein

Explanation:
The answer is b. Spectrin is a rod-shaped tetramer that, in association with actin and adducin, forms a hexagonal lattice that underlies the cytoplasmic surface of the red blood cell plasmalemma. Ankyrin and band 3 protein and band 1 protein anchor the hexagonal lattice to the cell membrane. Glycophorins and band 3 proteins are transmembrane proteins.

12. A six-month-old baby boy, when seen by his pediatrician,, exhibits an enlarged tongue and an enlarged liver. Additionally, the baby has problems with swallowing. The pediatrician should suspect that the child is suffering from

a. cranial nerve X (vagus nerve) disorder
b. Pompe's disease
c. McArdle's syndrome
d. Tay-Sachs disease
e. Tarui's disease

Explanation:
The answer is b. Pompe's disease is a lethal glycogen-storage disease that affects infants and usually causes death by the second or third year of life. The baby is missing lysosomal acid maltase, and as glycogen accumulates in the lysosomes of the liver, heart, and some skeletal muscles, these organs enlarge. Although cranial nerve X distributes through much of the body, its malfunction does not cause any of the symptoms present in this infant. McArdle's syndrome has an adult onset, and the symptoms of Tarui's disease usually are noted only after vigorous physical exercise. Tay-Sachs disease is not accompanied by swollen tongue or enlarged liver.

13. A patient with Kartagener's syndrome has a genetic disorder that is known to

a. affect microfilaments
b. affect intermediate filaments
c. have defective dynein
d. have defective kinesin
e. have defective α-tubulin

Explanation:
The answer is c. Kartagener's syndrome is due to an autosomal recessive disorder that affects ciliary motion because the microtubule-associated protein, dynein, is either defective or not present. The tubulins of microtubules are formed normally, and microtubule assembly, per se, is not affected. Microfilaments and intermediate filaments are not affected in Kartagener's syndrome.

14. A patient who had surgery for ovarian cancer is placed on a combination of cisplatin and taxol therapy. Taxol is an antimitotic agent that

a. affects microfilaments
b. affects intermediate filaments
c. has defective dynein
d. prevents the polymerization of microtubules
e. stabilizes microtubules

Explanation:
The answer is e. Unlike most antimitotic agents that interfere with polymerization or depolymerization of microtubules, taxol stabilizes microtubules, so they cannot shorten or lengthen. In this fashion the mitotic spindle apparatus cannot change its length, thus preventing the movement of the chromosomes during the mitotic event. Dynein, microfilaments, and intermediate filaments are unaffected by taxol.

15. A patient with lymphoma that involves his small intestines is treated with a various chemotherapeutic agents, including vincristine. This antimitotic substance acts on

a. α-actinin
b. dynein
c. tubulin
d. myosin I
e. actin

Explanation:
The answer is c. Vincristine interferes with polymerization of microtubules and halts mitosis, thus killing dividing cells. Vincristine has no effect on α-actinin, dynein, myosin I, or actin.

16. A two-week-old infant was seen by her pediatrician because of blistering of the fingers and the back of her hands. The blisters were quite large and the results of the biopsy indicated that blistering occurred in the basal layer of the epidermis. The diagnosis was epidermolysis bullosa simplex. This disease is caused by mutations in the

a. tubulins
b. neurofilaments
c. G actins
d. keratins
e. chondroitins

Explanation:

The answer is d. Blistering in infants that occurs on the regions of the skin that are exposed to friction and pressure is a result of mutations in types 14 and 5 keratins. Tubulins, neurofilaments, G actins, and chondroitins are not affected.

17. Early in the morning, a male patient sees his physician because he and his wife have been trying to start a family. According to the patient, his wife was told that she is able to become pregnant, and he wants to have the physician check him for sterility. The physician notices that the patient has a heavy cough. Upon questioning, the patient reveals that he also coughs in the evening, produces a lot of sputum, and has had numerous colds and even occasional pneumonia. The doctor asks for a sperm sample but already is thinking of a possible diagnosis of Kartagener's syndrome, a genetic disorder that affects

a. a number of keratins
b. microtubule-associated proteins
c. thin filaments
d. intermediate filaments
c. thick filaments

Explanation:
The answer is b. Kartagener's syndrome is due to an autosomal recessive disorder that affects ciliary motion because a microtubule-associated protein, dynein, is either defective or not present. The tubulins of microtubules are formed normally and microtubule assembly, per se, is not affected. Thin filaments, thick filaments, and intermediate filaments are not affected in Kartagener's syndrome.

18. A 55-year-old patient was placed on tetracycline therapy and a week later returns to the physician, indicating that the antibiotic did not alleviate his symptoms. During their conversation the physician determines that the patient took the tetracycline capsules with milk. Which of the following components of milk interfered with theaction of the drug?

a. calcium
b. lipid
c. sodium
d. rennin
e. potassium

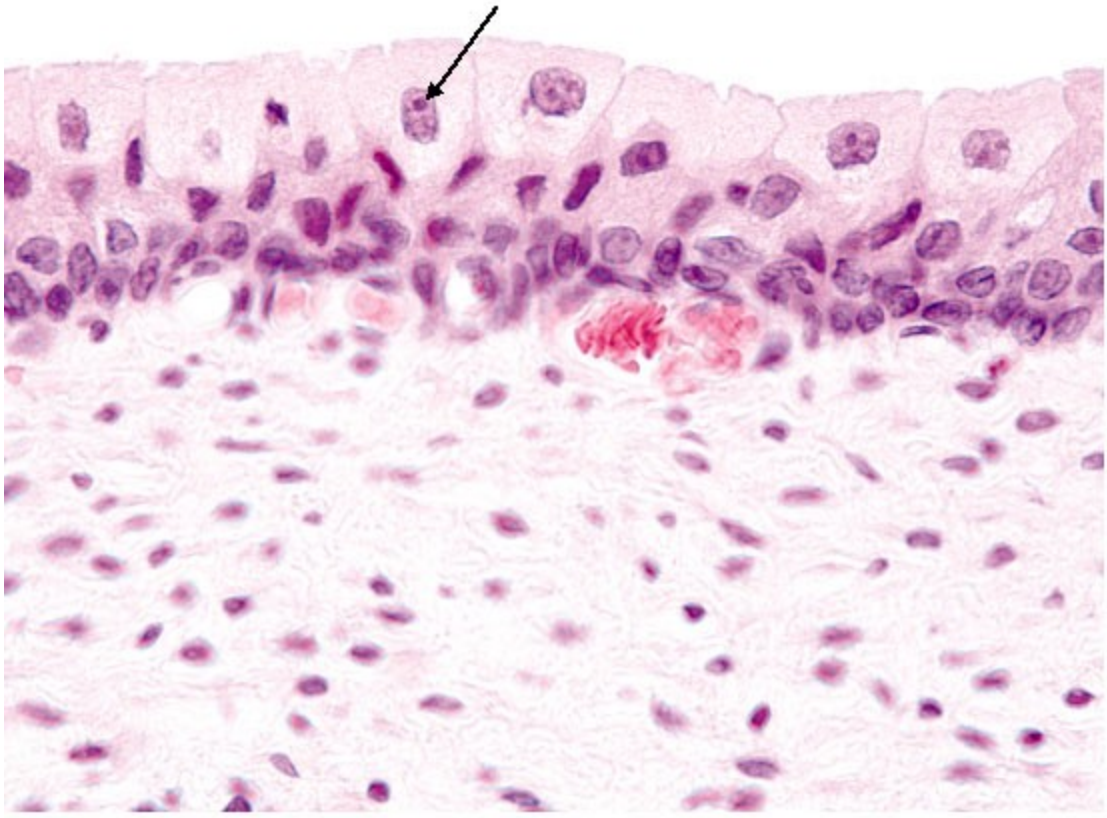
Explanation:
The answer is a. Calcium taken within an hour of oral tetracycline ingestion interferes with the absorption of the antibiotic through the membranes of the cells lining the stomach and small intestines. Lipid, sodium, and potassium do not interfere with tetracycline absorption. Rennin, an enzyme that curdles milk protein, has no effect on the absorption of tetracycline.

19. A 77-year-old female is having problems sleeping, and her physician prescribed flurazepam, a sleep aid. The patient reports that she feels “groggy” for about 2 days after having taken the drug. Flurazepam is

a. destroyed by the acidic conditions in the stomach
b. inactivated by pepsin in the stomach
c. denatured by trypsin in the duodenum
d. inactivated by the P-450 enzyme system of the liver
e. destroyed by proteasomes in the jejunum

Explanation:
The answer is d. Many drugs are inactivated by the P-450 enzyme system of the liver. In this patient the level of this enzyme system is depressed; therefore, flurazepam is not inactivated in 18 hours, as in most patients, but has a longer half-life, which accounts for the groggy feeling even 2 days later. Flurazepam is not affected by HCl, pepsin, or trypsin, nor does it enter the proteasome system of the cell.

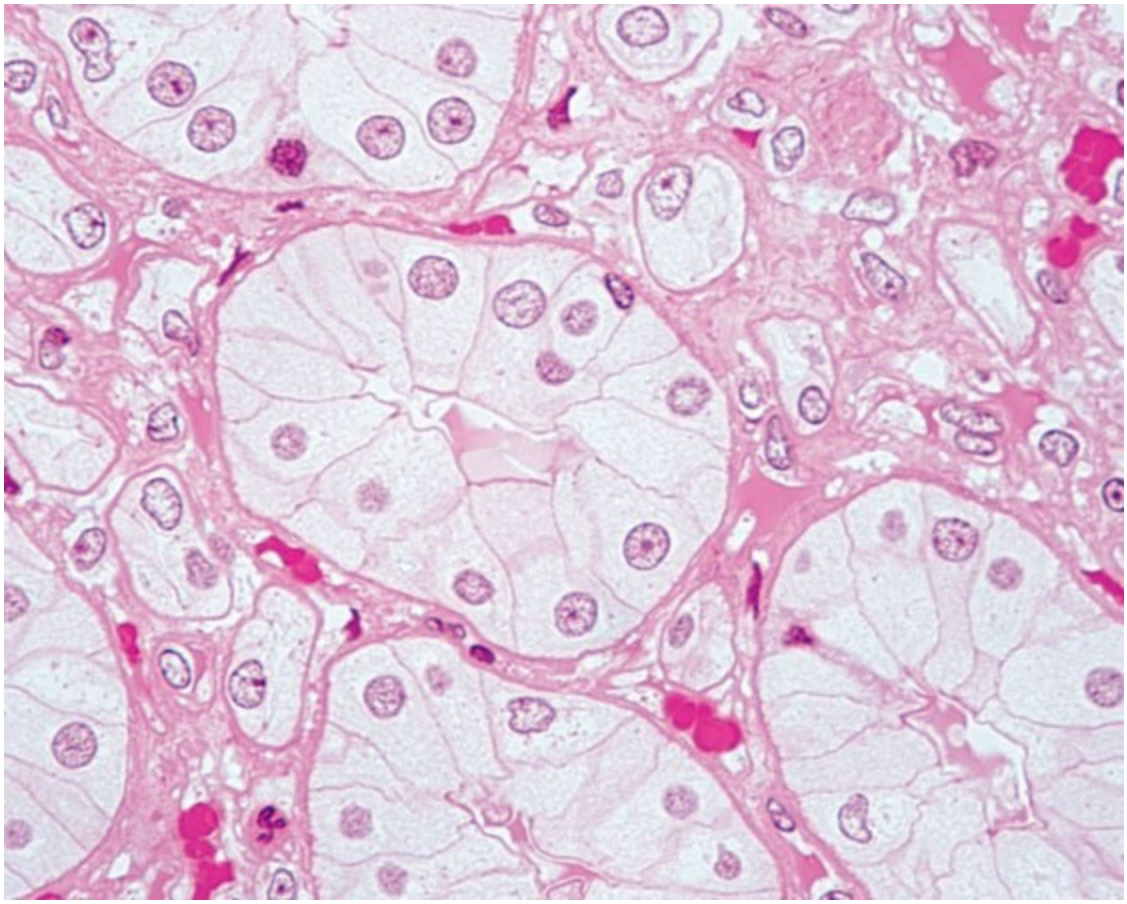
20. In Fig. Img_001, the region at the arrow tip is the place where



a. assembly of the small subunit of ribosomes occurs
b. synthesis of proteins for the large ribosomal subunit occurs
c. degradation of tRNA occurs
d. amino acids are coupled to tRNA
e. mRNA synthesis occurs

Explanation:
The answer is a. The arrow tip is in the nucleolus and it is here that the assembly of both small and large ribosomal subunits occur. rRNA, not mRNA, is transcribed in the nucleolus, and tRNA is not degraded here. Protein synthesis as well as the coupling of amino acids to tRNA occur in the cytoplasm, not in the nucleolus.

21. In Fig. Img_002, the collecting tubule of the kidney, water enters the lumen via

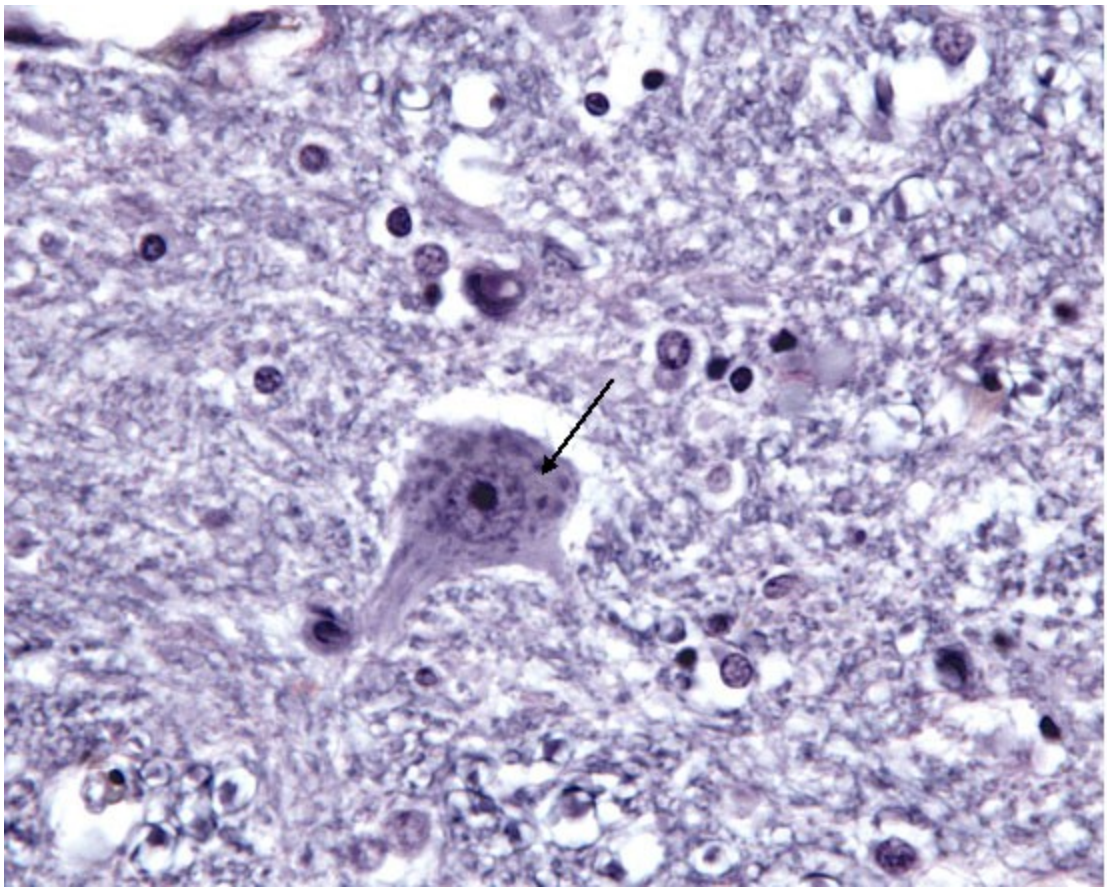


a. pinocytosis
b. endocytosis
c. aquaporins

d. ion channels
e. carrier proteins

Explanation:
The answer is c. Water leaves the cells of the collecting tubule to enter its lumen by way of structures known as aquaporins. Pinocytosis and endocytosis both refer to substances entering the cell. Ion channels are designed to carry ions along a concentration gradient in or out of a cell, whereas carrier proteins can move ions as well as small molecules along and/or against a concentration gradient.

22. In Fig. Img_004, the structure at the tip of the arrow is responsible for which of the following?



a. synthesis of ATP
b. assembly of microtubules
c. assembly of neurofilaments
d. synthesis of lysosomal proteins
e. assembly of neurotubules

Explanation:
The answer is d. The large cell in the center of this field is a multipolar neuron in the gray matter of the spinal cord. The arrow is pointing to a structure known as a Nissl body, which was noted by electron microscopy to be composed of rough ER, the region where proteins that are to be packaged, such as lysosomal proteins, are synthesized whereas microtubules (also known as neurotubules) and neurofilaments are assembled in the cytoplasm, but not involving the rough ER.

23. A patient who is unable to metabolize long-chain fatty acids has problems involving her

a. early endosomes
b. late endosomes
c. lysosomes
d. peroxisomes
e. proteasomes

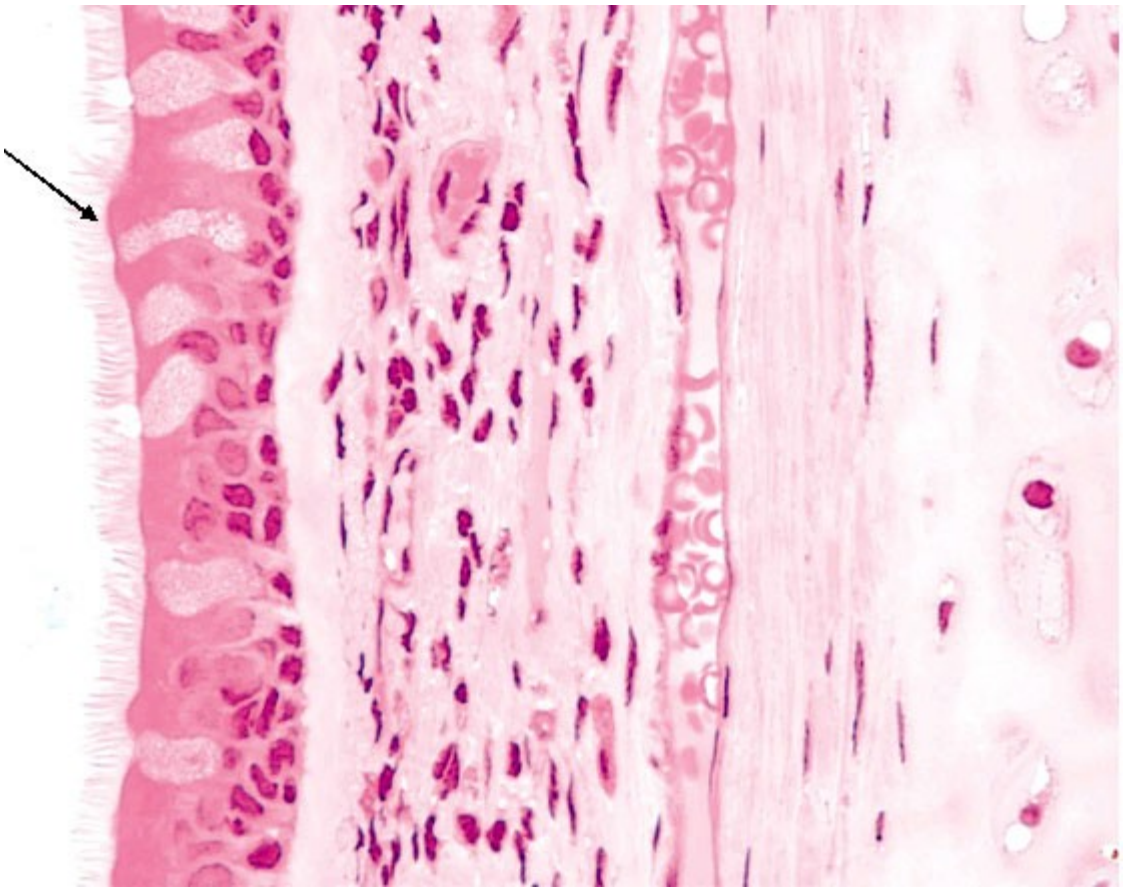
Explanation:
The answer is d. Peroxisomes function in the catabolism of long-chain fatty acids, in detoxifying noxious agents, and in killing bacteria. Early and late endosomes are organelles that participate in the endocytic and endolysosomal pathways, whereas proteasomes function in the catabolism of proteins.

24. Integrins are associated with which of the following structures?

a. zonula occludens
b. zonula adherens
c. fascia occludens
d. desmosomes
e. hemidesmosomes

Explanation:
The answer is e. Integrins are transmembrane proteins that are restricted to interact with the extracellular matrix. In epithelial cells they are localized in the basal surfaces and assist hemidesmosomes in adhering to the basal lamina. They do not participate in cell-to-cell contact, and all the other choices involve intracellular contact.

25. In Fig. Img_019, the core of the structures at the arrow tip is composed of



a. thin filaments
b. intermediate filaments
c. thick filaments
d. microtubules
e. actin filaments

Explanation:
The answer is d. The photomicrograph depicts a pseudostratified, ciliated columnar epithelium and the structures at the arrow tip are cilia. The core of each cilium is consists of an axoneme. Axonemes are composed of nine doublet microtubules surrounding two central singlet microtubules. Thin filaments (actin filaments) constitute the core of microvilli. Intermediate filaments and thick filaments are not associated with cilia.