Chapter 2
Cells and Tissues

2.1 Cells and Tissues

Cells are composed of their cytoplasm, which includes the cytosol and organelles; the nucleus and the surrounding plasma membrane. You should know that the plasma membrane is a double layer of phospholipid molecules and that these molecules have a hydrophilic end and a hydrophobic end. The plasma membrane contains proteins including the ATPase (the sodium-potassium pump) which moves sodium ions out of the cell while moving potassium ions into the cell. You should know the names and function of some of the organelles. For example you should know that mitochondria produce ATP and that ribosomes synthesise proteins from amino acids.

You will become familiar with the names of many cells. Often a word can be recognised as the name of a cell because it ends in “-cyte” or, if it is an immature cell, by ending in “-blast”. Four major types of tissue are identified in the body: epithelial, connective, muscle and neural tissues. Of course there are many subtypes within these categories. For example epithelial tissue may be squamous, cuboidal, columnar or glandular. Muscle may be skeletal, smooth or cardiac. Connective tissue is quite varied and you should be aware of the many different examples of tissue that are categorised as “connective”. For example, blood, bone, dermis, cartilage and tendon are all connective tissue.

1. Which structure within the cell produces ATP (adenosine triphosphate)?

A. the mitochondria
B. the nucleus
C. peripheral proteins
D. the endoplasmic reticulum

Answer is A: This is a basic function of mitochondria. All other answers are wrong.
2. Which of the following is NOT a component of the cell plasma membrane?
   A. cholesterol
   B. proteins
   C. microfilaments
   D. phospholipids

   Answer is C: microfilaments occur inside the cell.

3. Which list below contains the four types of tissue?
   A. extracellular fluid, skeletal tissue, glandular tissue, connective tissue.
   B. extracellular fluid, muscle tissue, glandular tissue, cartilaginous tissue.
   C. neural tissue, skeletal tissue, epithelial tissue, cartilaginous tissue.
   D. Neural tissue, muscle tissue, epithelial tissue, connective tissue.

   Answer is D: These are the four types. Extracellular fluid is not a tissue. Cartilage is a type of connective tissue.

4. Except for one, the following are types of cells. Which one is NOT a type of cell?
   A. platelets
   B. leucocytes
   C. macrophages
   D. osteoblasts

   Answer is A: Platelets are fragments of a cell (a megakaryocyte) bound by a membrane.

5. In which part of a cell does the process of making ATP from oxygen and glucose take place?
   A. lysosomes
   B. ribosomes
   C. mitochondria
   D. golgi apparatus

   Answer is C: ATP production is the function of mitochondria.

6. Which of the following is a function of membrane proteins?
   A. to process lipids and proteins for secretion through the plasma membrane
   B. to act as receptors for hormones
   C. to synthesise proteins from amino acids
   D. to act as a cytoskeleton to support and shape the cell

   Answer is B: One function of membrane proteins is to receive (amino acid based) hormones that cannot pass through the plasma membrane.
7. What is the difference between simple squamous cells and simple columnar cells?
   A. squamous cells are flattened while columnar cells are taller than they are wide.
   B. simple squamous cells are one layer thick while simple columnar cells are several layers thick.
   C. simple squamous cells are epithelial tissue while simple columnar cells are connective tissue.
   D. squamous cells are flattened while columnar cells are cuboidal.

   Answer is A: The names of the cells contains a description of their shape: either flat, or like columns. Simple refers to a single layer of cells.

8. Which of the following is NOT an example of a cell?
   A. macrophages
   B. lysosomes
   C. plasmocytes
   D. chondroblasts

   Answer is B: the suffix “–some” refers to an organelle within a cell. The other suffixes all indicate a type of cell.

9. Which cell organelles contain an acidic environment capable of digesting a wide variety of molecules?
   A. Lysosomes
   B. Ribosomes
   C. Centrosomes
   D. Golgi complex

   Answer is A: the prefix “lyso-” refers to the ability to dissolve or destroy molecules or cells.

10. Which form of transport through the plasma membrane requires the expenditure of energy by the cell?
    A. Facilitated diffusion
    B. Osmosis
    C. Active transport
    D. Diffusion

    Answer is C: The term “active” implies using energy (in the form of ATP) to move a molecule against its concentration gradient, while the other processes are all passive.

11. Which of the tissue types below consists of a single layer of cells?
    A. stratified squamous epithelial tissue
    B. glandular epithelium
C. areolar connective tissue  
D. simple columnar epithelial tissue

Answer is D: the word “simple” indicates a single layer of cells. Stratified means several layers (or strata) of cells.

12. One of the following is NOT a serous membrane. Which one?
   A. pleura  
   B. peritoneum  
   C. mucosa  
   D. pericardium

Answer is C: mucosa is a mucus membrane (& secretes mucus)

13. Which of the following is NOT made predominantly from epithelial tissue?
   A. In the dermis  
   B. In exocrine glands  
   C. In endocrine glands  
   D. In the endothelium of blood vessels

Answer is A: The dermis contains connective tissue, nervous tissue & muscle as well as epithelial tissue.

14. What are tendons and ligaments composed of?
   A. Dense connective tissue  
   B. Liquid connective tissue  
   C. Muscular tissue  
   D. Epithelial tissue

Answer is A: tendons & ligaments are dense CT. This is strong as there is a high proportion of fibres.

15. What is the composition of the intercellular matrix in connective tissue?
   A. Cells and fibres  
   B. Serous and mucus membranes and lamina propria  
   C. Protein fibres and ground substance  
   D. Interstitial fluid

Answer is C: “intercellular” means between cells. So matrix is fibres & ground substance (but no cells).

16. Which statement about the plasma membrane is INCORRECT?
   A. It is selectively permeable.  
   B. It is composed of two layers of glycoprotein molecules.  
   C. It contains receptors for specific signalling molecules.
D. The plasma membranes of adjacent cells are held together by desmosomes.

Answer is B: The PM is indeed made of two layers, but they are phospholipid (not glycoprotein) molecules.

17. Which of the following is NOT epithelial tissue?

A. the epidermis  
B. glandular tissue  
C. the internal lining of blood vessels  
D. the dermis

Answer is D: The dermis contains some of all four types of tissue.

18. Which of the following is NOT a cell found in connective tissue?

A. adipocytes  
B. chondroblasts  
C. keratinocytes  
D. osteoblasts

Answer is C: Keratinocytes are in the epidermis which is epithelial tissue. The other cell types occur in fat, cartilage and bone.

19. What tissue has cells that are closely packed and that have one surface attached to a basement membrane and the other free to a space?

A. epithelial tissue  
B. muscle tissue  
C. connective tissue  
D. nervous tissue

Answer is A: This is a definition of epithelial tissue.

20. What is the name of the mechanism that ensures that there is a higher concentration of sodium ions in the extracellular fluid than in the intracellular fluid?

A. Facilitated diffusion  
B. The sodium-potassium pump  
C. Secondary active transport  
D. Osmosis

Answer is B: The “pump” (or ATPase) transports Na\(^+\) out and K\(^+\) into the cell.

21. What are lysosomes, centrosomes and ribosomes example of?

A. stem cells  
B. organelles within a cell  
C. sensory receptors in the dermis  
D. exocrine glands

Answer is B: the suffix “–some” refers to small body or organelle within a cell.
22. What does simple columnar epithelial tissue refer to? Tissue with
   A. a single layer of cells longer than they are wide.
   B. a single layer of cells whose length, breadth and depth are about the same size.
   C. several layers of cells, all of the same type.
   D. several layers of cells but without a basement membrane.

   Answer is A: simple = one layer. Columnar means oblong or shaped like a column.

23. Which of the following is NOT an example of connective tissue?
   A. blood
   B. bone
   C. tendon
   D. epidermis

   Answer is D: the epidermis (on top of the dermis) is epithelial tissue.

24. What is the function of phospholipids in the plasma membrane?
   A. to maintain the intracellular fluid at a similar composition to that of the interstitial fluid.
   B. to form channels to selectively allow passage of small molecules.
   C. to act as receptors for signalling chemicals.
   D. to present a barrier to the passage of water-soluble molecules.

   Answer is D: molecules that are soluble in water cannot pass through lipid (fat). So the phospholipids are a barrier. The functions described by B. & C. are performed by other molecules in the plasma membrane.

25. Which one of the following cell types is found in epithelial tissue?
   A. plasma cells
   B. leucocytes
   C. keratinocytes
   D. chondroblasts

   Answer is C: keratinocytes produce keratin, the protein of the epidermis, which is epithelial tissue.

26. Which of the following is NOT part of the plasma membrane of a cell?
   A. integral proteins
   B. glycoproteins
   C. plasma proteins
   D. peripheral proteins

   Answer is C: as the name implies, plasma proteins are found in the blood plasma. Not to be confused with the plasma membrane.
27. A major role for mitochondria is to
   A. transcribe the information in DNA (deoxyribonucleic acid)
   B. produce ATP (adenosine triphosphate)
   C. synthesise proteins from amino acids
   D. use enzymes to lyse molecules
   Answer is B: ATP is only produced within the mitochondria.

28. Choose the tissue below that is one of the four primary types of body tissue.
   A. epidermal tissue
   B. epithelial tissue
   C. interstitial tissue
   D. osseous tissue
   Answer is B: epithelial is a major tissue type (as is muscle, nervous & connective)

29. What are the primary types of tissue in the body?
   A. Muscle, nervous, connective and epithelial
   B. Muscle, nervous, connective, osseous and epithelial
   C. Muscle, nervous, connective, osseous, blood and epithelial
   D. Muscle, nervous, connective, glandular and epithelial
   Answer is A: There are 4 major types (not 5 or 6). Osseous & blood are also connective, while glandular tissue is also epithelial.

30. What is the name of the membrane that surrounds the lungs?
   A. visceral peritoneum
   B. parietal peritoneum
   C. visceral pleura
   D. dura mater
   Answer is C: Pleura is around the lung, while visceral refers to the layer of the pleura that is attached to the lung surface.

31. What is a role performed by mitochondria?
   A. contain enzymes capable of digesting molecules
   B. produce ATP
   C. synthesise proteins
   D. synthesise fatty acids, phospholipids & cholesterol
   Answer is B: mitochondria produce ATP. The other tasks are performed by lysosomes, ribosomes and endoplasmic reticulum respectively.
32. Which of the following is NOT found in the plasma membrane?
   A. proteins
   B. cholesterol
   C. endoplasmic reticulum
   D. phospholipids

   Answer is C: endoplasmic reticulum is an organelle and found within the cell.

33. Which one of the following cell types is found in epithelial tissue?
   A. mast cells
   B. adipocytes
   C. chondroblasts
   D. keratinocytes

   Answer is D: These cells produce keratin, the protein of the stratum corneum.

34. Which of the following is NOT part of the plasma membrane of a cell?
   A. phospholipid
   B. glycoprotein
   C. chromatin
   D. cholesterol

   Answer is C: chromatin makes up chromosomes.

35. A major role for mitochondria is to
   A. synthesise fatty acids, phospholipids & steroids
   B. deliver lipids and proteins to plasma membrane for secretion
   C. synthesise proteins from amino acids
   D. produce ATP (adenosine triphosphate)

   Answer is D: mitochondria produce ATP from glucose.

36. Choose the tissue below that is NOT one of the four primary types of body tissue.
   A. connective tissue
   B. muscular tissue
   C. nervous tissue
   D. osseous tissue

   Answer is D: osseous tissue (or bone) is a connective tissue.

37. What is the purpose of mitochondria?
   A. to store the nucleolus and chromatin
   B. to produce adenosine triphosphate
C. to support and shape the cell.
D. they produce enzymes to break down molecules

Answer is B: Mitochondria are the site of ATP production

38. The plasma membrane of a cell contains molecules that have a hydrophobic end and a hydrophilic end. What are they called?
   A. phospholipids
   B. cholesterol
   C. integral proteins
   D. glycoproteins

   Answer is A: the phosphate end is hydrophilic (water soluble) while the lipid end is hydrophobic (insoluble in water).

39. Adipocytes are found in which type of tissue?
   A. muscle tissue
   B. epithelial tissue
   C. nervous tissue
   D. connective tissue

   Answer is D: adipocytes are found in fat (adipose tissue) which is a type of connective tissue.

40. What is the role of mitochondria? To:
   A. function in cell division
   B. synthesise proteins
   C. form part of the plasma membrane
   D. synthesise fatty acids, phospholipids and steroids.

   Answer is C: mitochondria produce ATP

41. Which one of the following cell types is found in epithelial tissue?
   A. mast cells
   B. adipocytes
   C. chondroblasts
   D. melanocytes

   Answer is D: melanocytes produce melanin to protect the skin from ultraviolet radiation and it results in tanning of the skin.

42. What is the difference between “loose” connective tissue (CT) and “dense” connective tissue?
   A. Fibres occupy most of the volume in dense CT
   B. Dense CT includes cartilage, loose CT does not.
C. Loose CT has a good blood supply while dense CT does not.
D. Loose CT has no fibres (and dense CT does).

Answer is A: the preponderance of fibres is what makes the CT “dense”. Cartilage is classified as supportive CT.

43. Facilitated diffusion refers to the process of
A. movement along a concentration gradient assisted by protein carrier molecules.
B. movement of ions and molecules along a concentration gradient.
C. transport of molecules and ions against their concentration gradient.
D. water movement through a semi-permeable membrane

Answer is A: facilitated refers to the role of the protein carriers. The other choices refer to diffusion, active transport and osmosis respectively.

44. What do fibroblasts, chondroblasts, osteoblasts and haemocytoblasts have in common?
A. they are all types of white blood cell.
B. they are all macrophages.
C. they are all immature cells.
D. they are all types of epithelial cell.

Answer is C: the suffix “-blast” implies that these cells have not yet finished their differentiation. That is are immature.

45. Which is NOT true of connective tissue (CT)?
A. the cells are closely packed
B. the tissue contains protein fibres and ground substance.
C. types include loose CT, dense CT and liquid CT.
D. CT contains white blood cells.

Answer is A: being close packed in a property of epithelial tissue. In CT the cells are widely spaced, being separated by the ground substance.

46. Active transport across the plasma membrane may be described by which statement?
A. active transport requires energy from ATP.
B. active transport is also known as endocytosis.
C. active transport moves molecules along their concentration gradient.
D. active transport is the movement of lipid-soluble molecules through the plasma membrane.

Answer is A: this is the only correct answer. The others are not true.
47. Which of the following cell types denotes an immature cell?
   A. macrophages  
   B. monocytes  
   C. osteoblasts  
   D. ribosomes  
   Answer is C: The suffix “-blast” indicates that the cell is immature.

48. Choose the membrane that is **NOT** a serous membrane.
   A. pleura  
   B. peritoneum  
   C. pericardium  
   D. lamina propria  
   Answer is D: the lamina propria is a “basement membrane” attached to epithelial tissue. The others are serous membranes.

49. Which organelle is the site of ATP production?
   A. the nucleus  
   B. endoplasmic reticulum  
   C. mitochondria  
   D. golgi apparatus  
   Answer is C: the mitochondria is where ATP is produced.

50. Which of the following is **ONE** major function of epithelial cells?
   A. movement  
   B. secretion  
   C. support of other cell types  
   D. transmit electrical signals  
   Answer is B: glandular tissue are one type of epithelial tissue and their function is to produce material to secrete.

51. What are the major types of tissue in the body?
   A. nervous, muscle, epithelial, connective.  
   B. squamous, cuboidal, columnar, transitional.  
   C. osteocytes, chondrocytes, leucocytes, adipocytes.  
   D. protein, adipose, cartilage, osseous.  
   Answer is A: choice C refers to cell types; B is a list of epithelial tissue. Protein is applied to molecules.
52. Which of the following is NOT one of the organelles within a cell?
   A. desmosome
   B. endoplasmic reticulum
   C. mitochondrion
   D. golgi apparatus

   Answer is A: desmosome (despite having the suffix “-some”) are not within the cell. They are structures that join adjacent plasma membranes to each other.

53. Which list contains the main body tissue types?
   A. glandular, connective, osseous, nervous
   B. epithelial, nervous, connective, muscle.
   C. endothelial, connective, muscle, cartilaginous
   D. epithelial, cartilaginous, muscle, glandular

   Answer is B: the terms osseous, glandular and cartilaginous disqualify the other choices.

54. The process of “diffusion” through a membrane may be described by which of the following?
   A. the movement of ions and molecules away from regions where they are in high concentration towards regions where they are in lower concentration.
   B. the use of energy from ATP to move ions and small molecules into regions where they are in lower concentration.
   C. the plasma membrane engulfs the substance and moves it through the membrane.
   D. the use of energy from ATP to move water molecules against their concentration gradient.

   Answer is A: the choices with ATP are nonsense. While choice C refers to endocytosis.

55. The process of “active transport” through a membrane may be described by which of the following?
   A. the movement of ions and small molecules away from regions where they are in high concentration.
   B. the use of energy from ATP to move ions and small molecules into regions where they are in lower concentration.
   C. the plasma membrane engulfs the substance and moves it through the membrane.
   D. the use of energy from ATP to move ions and small molecules against their concentration gradient.

   Answer is D: energy (ATP) is required to force molecules against their concentration gradient.
56. Which of the following is the smallest living structural unit of the body?
   A. atom
   B. molecule
   C. organelle
   D. cell

   Answer is D: the cell is smallest structural unit that is deemed to be alive.

57. Which of the following enables ions such as sodium to cross a plasma membrane?
   A. phospholipid bilayer
   B. peripheral proteins
   C. integral proteins
   D. desmosomes

   Answer is C: one function of integral protein in the PM is to form channels to allow for the passage of ions.

58. Cell membranes can maintain a difference in electrical charge between the interior of the cell and the extracellular fluid. What is this charge difference called?
   A. excitability
   B. the membrane potential
   C. the action potential
   D. the sodium-potassium pump

   Answer is B: the inside of a cell is negative while the exterior side of the membrane is positive. This difference in charge constitutes a difference in electrical potential (or voltage), known as the resting membrane potential. An action potential is generated when the membrane is stimulated and the potential reversed.

59. The resting membrane potential of a cell is the consequence of which of the following concentrations of ions?
   A. High K+ and Cl− outside the cell and high Na+ and large anions inside the cell.
   B. High K+ and Na+ outside the cell and high Cl− and large anions inside the cell.
   C. High Cl− and Na+ outside the cell and high K+ and large cations inside the cell.
   D. High Ca2+ and Na+ outside the cell and high K+ and large cations inside the cell.

   Answer is C: These ionic species are largely responsible for the membrane potential (cations are negative ions). While there is a higher concentration of Ca outside the cell than inside, there are fewer Ca than Cl ions.
60. What is one function of mitochondria? To
A. produce enzymes to break down molecules
B. produce molecules of ATP
C. hold adjacent cells together
D. allow passage of molecules through the plasma membrane

Answer is B: Mitochondria are organelles within which ATP is made.

61. Membrane proteins perform the following functions EXCEPT one. Which One?
A. form the glycocalyx
B. act as receptor proteins
C. form pores to allow the passage of small solutes
D. behave as enzymes.

Answer is A: the glycocalyx refers to molecules in the plasma membrane that have a carbohydrate chain attached (prefix “glyco-”).

62. Facilitated diffusion differs from active transport because facilitated diffusion:
A. requires energy from ATP
B. moves molecules from where they are in lower concentration to higher concentration
C. moves molecules from where they are in higher concentration to lower concentration.
D. involves ions & molecules that pass through membrane channels.

Answer is C: diffusion always refers to movement from high to low concentration (without energy expenditure). Facilitated refers to the assistance provided by a transport molecule that is designed for the purpose.

63. Which of the following is NOT a connective tissue?
A. blood
B. mesothelium
C. fat
D. tendon

Answer is B: mesothelium is simple squamous epithelium that is found in serous membranes.

64. The cells that are found in tendons are called:
A. osteocytes
B. adipocytes
C. haemocytoblasts
D. fibroblasts
Answer is D: Simple Squamous. A single layer of flat (squashed) cells so diffusion through the layer takes place easily. Lines heart, lymph & blood vessels (known as endothelium). Called mesothelium when in serous membranes.

65. Which one of the following terms best describes the structure of the cell membrane:
A. fluid mosaic model
B. static mosaic model
C. quaternary structure
D. multilayered structure

Answer is A: “fluid” implies the structure can move and change (not like a brick wall); mosaic refers to the presence of proteins scattered among the glycolipids.

66. Which one of the following terms best describes a phospholipid. It consists of a:
A. polar head and polar tail
B. non-polar head and a polar tail
C. polar head and non-polar tail
D. non-polar head and a non-polar tail

Answer is C: polar = hydrophilic head of phosphate (which can dissolve in the aqueous extracellular solution because water molecules are polar); non-polar = hydrophobic tails of lipid, which being non-polar, cannot dissolve in aqueous solutions.

67. One of the functions of integral proteins in cell membranes is to:
A. maintain the rigid structure of the cell
B. support mechanically the phospholipids
C. interact with the cytoplasm
D. form channels for transport functions

Answer is D: some proteins form channels which allow molecules and ions to enter the cell.

68. Which one of the following best describes what a cell membrane consists of?
A. lipids, proteins, ribosomes
B. lipids, cholesterol, proteins
C. cholesterol, proteins, cytoplasm
D. lipids, proteins, cytoplasm

Answer is B: these are the three major constituents. Ribosomes and cytoplasm are found inside the cell.
69. Which one of the following organelles is considered as the “energy producing” centre of the cell?

A. rough endoplasmic reticulum  
B. Golgi apparatus  
C. mitochondria  
D. ribosomes

Answer is C: mitochondria are where ATP molecules are produced from glucose.

70. What is the major function of lysosomes? They:

A. package proteins  
B. detoxify toxic substances  
C. catalyse lipid metabolism  
D. digest unwanted particles within the cell

Answer is D: the prefix “lys-” refers to the ability to alter molecules by dividing them into smaller pieces.

71. What is the purpose of the “sodium/potassium pump”

A. to perform endocytosis.  
B. to move sodium and potassium by facilitated diffusion.  
C. to perform bulk transport through the plasma membrane.  
D. To produce a concentration gradient for sodium ions

Answer is D: a concentration gradient is set up by the use of energy to move Na ions to where they are in greater concentration. This requirement for energy means choice B is wrong.

72. Which of the following is NOT a type of cell?

A. ribosome  
B. haemocytoblast  
C. neutrophil  
D. phagocyte

Answer is A: a ribosome is a cell organelle, not a cell type.

73. What is the name of the mechanism that ensures that there is a higher concentration of sodium ions in the extracellular fluid than in the intracellular fluid?

A. Facilitated diffusion  
B. The sodium-potassium pump  
C. Secondary active transport  
D. Osmosis

Answer is B: the “pump” exchanges Na for K and uses energy from ATP to function.
74. What is the name given to the type of transport where glucose or an amino acid binds to a receptor protein on the plasma membrane, which then moves the molecule into the cell without the expenditure of energy?

A. facilitated diffusion  
B. bulk transport  
C. secondary active transport  
D. active transport

Answer is A: the membrane protein facilitates the entry into the cell. No energy is expended so it is not active transport.

75. What is the name given to the movement of glucose or amino acids from the gut into the cells lining the gut, when they bind to a transport protein that has also bound a sodium ion. The sodium ion is entering the cell along its concentration gradient.

A. facilitated diffusion  
B. the sodium potassium pump  
C. active transport  
D. secondary active transport

Answer is D: the sodium ion was transported out of the cell with the use of energy in order to set up the sodium concentration gradient. This gradient then allows other molecules to enter the cell along with sodium’s re-entry. This is active (because energy used), but secondary as it occurs as a result of the previous active transport event.

76. Mitochondria produce which of the following?

A. ATP  
B. DNA  
C. RNA  
D. proteins

Answer is A: adenosine triphosphate (ATP)

77. Why does the plasma membrane of a cell present a barrier to the movement of electrolytes through it?

A. There are no channels in the membrane for the passage of electrolytes.  
B. Electrolytes are not soluble in the lipid of the membrane.  
C. Electrolytes are too large to pass through membrane channels.  
D. Membrane proteins electrically repel charged particles.

Answer is B: electrolytes, being charged particles are not able to dissolve their way through the lipid plasma membrane (which is non-polar). Hence it is a barrier to them.
78. Which of the following statements about “leak channels” in the plasma membrane is correct?

A. Proteins that form these channels bind to solutes to allow them to pass into the cell.
B. They are passageways formed by proteins to allow water and ions to move passively through the membrane.
C. They allow small ions and molecules to move between adjacent cells.
D. They are formed by glycoprotein and proteoglycans to allow hormones to enter cells.

Answer is B: this is the definition of leak channels. They may be “gated” which means shut until stimulated to open. J refers to facilitated diffusion.

79. What are the primary types of body tissue?

A. connective tissue, blood, muscle tissue, nervous tissue, epithelial tissue.
B. muscle tissue, osseous tissue, epithelial tissue, nervous tissue, blood, connective tissue.
C. nervous tissue, epithelial tissue, muscle tissue, connective tissue.
D. epithelial tissue, connective tissue, adipose tissue, muscle tissue, nervous tissue.

Answer is C: These are the four primary types. Blood is not a “type” of tissue.

80. Epithelial and connective tissue differ from each other in which of the following characteristics?

A. epithelial tissue contains fibres but connective tissue does not.
B. connective tissue is avascular but epithelial tissue is well-vascularised.
C. cells in epithelial tissue are closely packed, whereas in connective tissue they are not.
D. connective tissue includes tissue that makes up glands, but epithelial tissue does not occur in glands.

Answer is C: The other choices are not correct.

81. Which of the following is a component of the plasma membrane of a cell?

A. plasma
B. glycolipid
C. plasma proteins
D. cholesterol

Answer is D: despite the term “plasma” A & C are wrong. And it is phospholipids, not glycolipids that occur in the membrane.
82. What term is used to describe the movement of dissolved particles along (or down) their concentration gradient?
   A. endocytosis  
   B. active transport  
   C. osmosis  
   D. diffusion  
   Answer is D: Following the concentration gradient is a passive process. Choice C applies only to water molecules.

83. Which of the following molecules cannot pass through the plasma membrane?
   A. water molecules  
   B. non-polar molecules  
   C. amino acid based hormones  
   D. fat-soluble molecules  
   Answer is C: These hormones are not lipid soluble and too large to pass through channels.

84. Which of the following is a connective tissue?
   A. pancreas  
   B. spinal cord  
   C. muscle  
   D. blood  
   Answer is D: Blood contains cells separated by a liquid matrix. Choices A & B are epithelial and nervous tissues.

85. Which of the following is an epithelial tissue?
   A. adipose tissue  
   B. the adrenal gland  
   C. the heart  
   D. blood  
   Answer is B: The adrenal gland is glandular epithelial tissue.

86. What is the major component of the plasma membrane of a cell?
   A. phospholipid  
   B. glycolipid  
   C. integral protein  
   D. cholesterol  
   Answer is A: Cholesterol and proteins are also present in the plasma membrane but as more minor components.
87. Which one of the following is **NOT** a function of membrane proteins?
   A. they form a structure called a glycocalyx
   B. they attach cells to each other
   C. they form passageways to allow solutes to pass through the membrane
   D. they from receptors which can bind messenger molecules

   Answer is A: the glycocalyx is thought of as membrane carbohydrates.

88. Facilitated diffusion through a membrane involves which of the following scenarios?
   A. the diffusion of water through a selectively permeable membrane along its concentration gradient.
   B. the movement of a molecule against its concentration gradient with the expenditure of energy
   C. the plasma membrane surrounding (engulfing) the molecule & the molecule moving into the cell.
   D. a molecule binding to a receptor which moves the molecule through the membrane without the expenditure of energy

   Answer is D: facilitation is by binding to a membrane protein.

89. The diffusion of water through a membrane is referred to as
   A. secondary active transport
   B. bulk transport
   C. osmosis
   D. endocytosis

   Answer is C: osmosis is a word that is reserved for the movement of water through a membrane.

90. What is the tissue that covers the body surface and lines internal tubes called?
   A. epithelial tissue
   B. connective tissue
   C. glandular epithelium
   D. muscle tissue

   Answer is A: epithelial tissue has one surface “open” to the exterior or to the contents of the tube.

91. Which of the following is true for connective tissue?
   A. it consists of cells, a basement membrane and intercellular matrix
   B. its cells are closely packed and held together by protein fibres.
   C. it has a high rate of cell division and no blood supply
   D. it is made of cells, protein fibres and ground substance

   Answer is D: Connective tissue includes fibres and cells which are not closely packed.
92. The cell membrane’s resting potential (about \(-70\) mV inside with respect to the outside) is due mainly to which of the following mechanisms?

A. The sodium potassium pump.
B. The diffusion of cations and anions through the membrane along their concentration gradients.
C. The diffusion of sodium and potassium across the cell membrane.
D. The presence inside the cell of anions too large to passively cross the cell membrane.

Answer is A: The ATPase pump shifts 3 Na\(^+\) out of the cell and 2 K\(^+\) into the cell. This disparity in positive charge is the major influence on the resting potential.

2.2 Cell Cycle (Mitosis and Protein Synthesis)

The cell nucleus contains chromosomes which are composed of molecules of DNA. DNA is composed of units called nucleotides which consist of a sugar (deoxyribose) attached to a phosphoric acid group (PO\(_3\)OH) and one of four bases. Chromosomes contain the code for the sequence of amino acids used to construct different proteins. Each amino acid is coded for by a particular sequence of three of the four bases (adenine, guanine, cytosine & thymine). This sequence is called a “codon”. mRNA “transcribes” this code then moves from the nucleus to a ribosome in the cytoplasm where it is “translated” and the protein is assembled by joining the required amino acids in the appropriate sequence.

Mitosis is the process by which a somatic cell divides to produce two cells with identical DNA. In this way an organism can grow. Before mitosis, the DNA must be duplicated. Hence the chromosomes (consisting of one strand or “chromatid”) double up by becoming two chromatids. Then during mitosis the two chromatids separate and move into the two daughter cells.

Meiosis occurs only in the gonads. This process results in four daughter cells. Human cells have two copies of each of 23 chromosomes, one copy being inherited from the father and the other copy from the mother. The gametes need to have only one copy of each of the 23 chromosomes, so that when the sperm fuses with the ovum, the “diploid” number of 46 (two copies of each chromosome) is restored. Meiosis is the process by which cells reduce their number of chromosomes from 46 to 23 different chromosomes. Of the 23 chromosomes in a sperm (or ovum), some (between 0 and 23) will have come from the sperm owner’s mother and the rest from the sperm owner’s father. The same can be said of the 23 chromosomes in the ovum. In this way the resulting children will be genetically different from each of their parents (and siblings) as each sperm/ovum will have a different assortment of the 23 available chromosomes.
1. The term “chromatin” would be used in reference to which of the following?
   A. genetic substance
   B. cellular energy
   C. membrane support
   D. nuclear membrane

   Answer is A: Chromatin is DNA & the associated proteins so pertains to genetic material.

2. In protein synthesis, where does translation occur? In the:
   A. cytoplasm between ribosomes, tRNA and mRNA
   B. nucleus between ribosomes, tRNA and mRNA
   C. nucleus between DNA and mRNA
   D. cytoplasm between DNA and mRNA

   Answer is A: translation occurs in the cytoplasm (transcription occurs in the nucleus). DNA does not exist in the cytoplasm.

3. If the DNA strand sequence of bases is CTT AGA CTA ATA, what would the tRNA read?
   A. GAA TCT GAT TAT
   B. CUU AGA CUA AUA
   C. GAA UCU GAU UAU
   D. GUU ACA GUA AUA

   Answer is C: guanine (G) must be matched to cytosine (C) and vice versa. Adenine (A) must match with thymine (T). In RNA, uracil (U) replaces thymine, while both bind to adenine. Hence U must be matched to A.

4. Which one of the following statements best describes DNA?
   A. single stranded, deoxyribonucleic acid
   B. single stranded, ribonucleic acid
   C. double stranded, deoxyribonucleic acid
   D. double stranded, ribonucleic acid

   Answer is C: DNA is double stranded, while the “D” refers to “deoxy-”.

5. In which phase of mitosis would chromosomes line up at the centre of the spindle:
   A. anaphase
   B. interphase
   C. prophase
   D. metaphase

   Answer is D: Remember the metaphase plate occupies the middle of the cell.
6. In a cell cycle which phase takes the longest time to complete:
   A. anaphase
   B. interphase
   C. prophase
   D. telophase
   Answer is B: interphase is the time when the cell is performing its normal function and not dividing.

7. What is the purpose of meiosis? To produce:
   A. DNA
   B. somatic cells
   C. diploid cells
   D. haploid cells
   Answer is D: meiosis produces sperm or egg so these must have half the complement of chromosomes (be haploid) to allow for the full complement to be present (and not more!) when sperm combines with egg.

8. What results from the events that occur during metaphase of mitosis?
   A. The nuclear membranes form around two nuclei.
   B. The chromosomes are aligned on a plane in the centre of the cell.
   C. The chromosomes become visible and attach to the spindle fibres.
   D. The chromatids from each chromosome separate and move to opposite sides of the cell.
   Answer is B: during metaphase, chromosomes are arranged on a plane (the metaphase plate) in the middle of the cell, attached to microtubules of the spindle.

9. What is the name of the process of division of a somatic cell’s nucleus into two daughter nuclei?
   A. prophase
   B. cytokinesis
   C. mitosis
   D. meiosis
   Answer is C: mitosis involves somatic cells. Meiosis refers to the production of the sex cells.

10. In a strand of DNA, what is the combination of deoxyribose and phosphate and base known as?
    A. A ribosome
    B. A chromatid
C. A codon
D. A nucleotide

Answer is D: three nucleotides form a codon and many codons form a chromatid.

11. What happens during anaphase of mitosis?
A. spindle fibres pull each chromatid to opposite sides of the cell
B. the sense and non-sense strands “unzip” along their hydrogen bonds
C. RNA polymerase forms a complementary strand by reading the sense strand
D. the cell cytoplasm divides into two cells

Answer is A: separation of the two chromatids of a chromosome occurs at anaphase. Choice D is cytokinesis and begins in late anaphase and continues into telophase.

12. The process by which information is read from DNA, encoded and transported outside the nucleus is known as:
A. translation
B. transcription
C. encoding
D. catalysis

Answer is B: to “transcribe” is to record the information from a source and to record it at another place (onto mRNA). Then messenger RNA moves out of the nucleus

13. How many nucleotides are required to code for a single amino acid?
A. twenty
B. five
C. three
D. one

Answer is C: A sequence of three nucleotides constitute a codon. Each codon is specific for one of the 20 amino acids.

14. The combination of a sugar, a base and at least one phosphate group is given the general term of:
A. nucleoside
B. amino acid
C. polypeptide
D. nucleotide

Answer is D: a nucleoside is a nucleotide without a phosphate group.
15. The nucleus of the cell contains the master nucleic acid:
   A. DNA  
   B. RNA  
   C. mRNA  
   D. tRNA
   Answer is A: DNA exists in the nucleus. The other three are ribonucleic acids.

16. Which of the following is the correct combination of the components for the nucleic acid DNA?
   A. Phosphate, Ribose, Uracil  
   B. Phosphate, Deoxyribose, Proline  
   C. Phosphate, Ribose, Thymine  
   D. Phosphate, Deoxyribose, Adenine
   Answer is D: DNA has the sugar deoxyribose, proline is an amino acid that does not occur in DNA.

17. In the ribosome of a cell, the mRNA is read to produce the particular amino acid sequence for the formation of a protein. What is this process called?
   A. Translation  
   B. Transcription  
   C. Transportation  
   D. Transmutation
   Answer is A: translation occurs in the cytoplasm of a cell with a ribosome. It is when the information in mRNA is read to produce the sequence of amino acids needed to form a protein.

18. Which of the base pairings in DNA would be correct?
   A. A–T pair  
   B. A–G pair  
   C. C–T pair  
   D. C–A pair
   Answer is A: A pairs with T, while C pairs with G.

19. The combination of a sugar and a base is given the general term of:
   A. nucleoside  
   B. amino acid  
   C. polypeptide  
   D. nucleotide
   Answer is A: a nucleotide is formed from a nucleoside and a phosphate group.
20. The nucleic acid which carries the information for protein synthesis from the cell nucleus to the ribosomes is:
   A. DNA  
   B. RNA  
   C. mRNA  
   D. tRNA  

   Answer is C: “messenger” RNA carries the data (the message) from the chromosomes in the nucleus to the ribosomes in the cytoplasm.

21. Which of the following is the correct combination of the components for the nucleic acid RNA?
   A. Phosphate, Ribose, Uracil  
   B. Phosphate, Deoxyribose, Proline  
   C. Phosphate, Ribose, Thymine  
   D. Phosphate, Deoxyribose, Adenine  

   Answer is A: RNA must have the sugar ribose. Thymine exists in DNA but not RNA, where it is replaced with uracil.

22. In the nucleus of the cell DNA is used as a template to form mRNA. What is the process called?
   A. Translation  
   B. Transcription  
   C. Transportation  
   D. Transmutation  

   Answer is B: transcription refers to the conversion of information on DNA into the form of mRNA.

23. Which statement is true of the 23 chromosomes within a sperm?
   A. 23 chromosomes is the diploid number  
   B. 11 chromosomes came from the father, 11 chromosomes came from the mother, while one of either the Y or the X came from the father or mother respectively.  
   C. Some of the 23 came from the father and the rest came from the mother.  
   D. 11 chromosomes and the Y came from the father, while 11 chromosomes came from the mother.  

   Answer is C: A sperm has 23 chromosomes which is the haploid number. The male that produced the sperm has 46 chromosomes (23 pairs) in their somatic
cells – 23 each from the man’s father and mother. When sperm are produced, the 46 chromosome assemble and pair up. The man’s X and Y chromosomes pair up. Each pair of chromosomes then separates so that only one of each pair moves into a new sperm. Which one of the pair ends up in which sperm is a random process. It is possible that an individual sperm has any number of chromosomes between 0 and 23 that originated from the father.
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