

ANSWERS

2.3 Connective Tissue

64. a – b + c + d + e +

All connective tissue develops from mesenchyme. Mesenchymal cells are usually stellate and are found only in embryos or fetuses. Some cells with mesenchyme-like features, such as pericytes, may be found in adults. Although mesoderm is the main embryonic germinal layer from which mesenchyme develops, mesenchyme, especially in the head region, can also develop from ectoderm.

65. a – b + c + d + e +

Mesenchymal cells, which typically have long processes, do not possess clear boundaries when seen in histological preparations, because of their active involvement in the secretion of the components of the intercellular substance. Mesenchymal cells have well-developed regular oval nuclei with pronounced nucleoli. This is consistent with their function as actively synthesizing cells.

66. a + b + c + d – e –

67. a + b – c – d + e +

68. a – b – c – d + e –

Fibroblasts are the main cell type found in connective tissue. They synthesize both the amorphous and fibrous components of the intercellular substance including glycosaminoglycans (acid mucopolysaccharides, hyaluronic acid), collagen fibers, elastic fibers and reticular fibers.

69. a + b + c + d + e +

Loose connective tissue (areolar tissue) is composed of cells and amorphous intercellular matter in which are found fibers of various sorts. Loose connective tissue has a high water content and a rich blood capillary network.

70. a + b + c + d – e +

The intercellular substance of loose connective tissue is not readily visualized in preparations stained with hematoxylin and eosin and is only adequately preserved when special fixation procedures are adopted because of its high fluid content. Chondroitin sulfate, hyaluronic acid and proteoglycans are all commonly found in the intercellular substance of loose connective tissue.

71. a + b – c + d + e +

Collagen fibers are present in the intercellular substance of connective tissue and in the matrix of cartilage, bone and teeth. The basal lamina that is found under epithelial cells is composed of a non-fibrous form of collagen (often referred to as type IV collagen).

72. a – b – c + d + e +

73. $a + b - c - d + e +$
 Collagen is present in tendons, ligaments and aponeuroses (all of which are classified as dense connective tissue). Collagen is birefringent (anisotropic) when viewed with a polarizing microscope. Collagen is the main source of hydroxyproline as well as the most abundant protein found in the body.
74. $a - b - c + d + e -$
 Collagen fibers are very resistant to stretching and tearing. They have no ability to contract. If boiled, collagen is converted to glue. Collagen fibers are seen to have transverse banding (periodic cross striations) only at the electron microscope level.
75. $a + b - c + d + e +$
 Tropocollagen molecules are the basic molecules from which collagen fibers are formed. Tropocollagen is synthesized in the rough endoplasmic reticulum of the fibroblasts, packed in the Golgi complex and extruded to the extracellular space. The tropocollagen molecules become aligned and organized in an orderly sequence to form the typical cross-banded collagen fibers seen by electron microscopy.
76. $a - b - c - d - e -$
 The collagen of the matrix of hyaline cartilage differs in its chemical properties, molecular composition and antigenicity from the collagen found elsewhere in the body.
77. $a + b - c - d - e -$
78. $a + b - c + d - e -$
 Collagen fibers show longitudinal striations when seen by light microscopy. In the transmission electron microscope, collagen fibers of loose connective tissue show cross-banding with a periodicity of approximately 64nm. Reticular fibers seen by electron microscopy are also composed of unit fibrils with a similar periodic cross-banding to that seen in collagen.
79. $a - b - c + d - e -$
80. $a + b + c + d - e +$
81. $a + b - c - d + e +$
 Elastin is an important component of skin, blood vessels, epiglottis and loose connective tissue. Elastic fibers are yellowish in fresh tissue and are homogeneous as seen by light microscopy. Elastic fibers are formed by fibroblasts, but are also formed by smooth muscle cells, where they form part of the extracellular sheath. The amino acid, desmosine, is found exclusively in elastic fibers. Elastic fibers as seen in electron micrographs at high magnification are composed of bundles of microfibrils (11 nm in diameter) embedded in amorphous elastin.

82. $a - b + c + d + e +$

83. $a + b - c - d - e -$

84. $a + b + c + d + e +$

Reticular fibers are not readily seen in preparations stained with hematoxylin and eosin, but can be demonstrated by impregnation techniques using silver salts. Reticular fibers are PAS-positive owing to their high hexose content and are usually found in association with the basal laminae of epithelial cells. Reticular fibers are formed by fibroblasts. They lack color in fresh preparations. The fibers are branched and show the typical cross-banding and periodicity of collagen of which they are mainly composed when viewed by electron microscopy. Reticular fibers are abundant in the framework of lymph nodes, spleen, red bone marrow, liver, kidney and several endocrine glands.

85. $a + b + c - d - e -$

Fibrocytes are less active in terms of biochemical synthetic activities or secretion into the extracellular space, when contrasted with the fibroblasts from which they developed. This is manifest in the fibrocytes being smaller, having fewer cytoplasmic processes, being more spindle-shaped, having less acidophilic cytoplasm and less rough endoplasmic reticulum.

86. $a + b + c + d + e +$

Macrophages are phagocytic cells. This can be demonstrated by their ability to engulf injected particulate vital dyes. They also have large numbers of lysosomes connected with their intracellular digestive processes. Macrophages may be mobile and able to wander through the tissues, or they may be fixed (for example, the Kupffer cells of the liver).

87. $a + b + c + d - e +$

Foreign body giant cells are formed by the fusion of macrophages at the site of some foreign body that has entered the tissue. This gives them a multi-nucleated appearance. These foreign body giant cells have pronounced phagocytic abilities and are often able to deal with large bodies that individual macrophages are unable to cope with.

88. $a + b + c + d + e +$

Adipose tissue is a type of connective tissue and may constitute up to 20% or more of the total body weight of adults. Adipose tissue is an important reservoir of energy and provides important body insulation. The layer of adipose tissue in the soles of the feet has a shock-absorbing function.

89. $a - b + c + d + e +$
 Fat cells are especially abundant in the hypodermis, though they are also found to a lesser degree in the dermis. Fat cells become quite abundant in the parathyroid glands of adults. Fat cells form the main component of yellow bone marrow and are responsible for its yellow coloration.
90. $a + b + c - d + e -$
 A number of hormones have a marked influence on the metabolism of adipose tissue. These include thyroxine, growth hormone and glucocorticoids.
91. $a - b + c - d + e -$
 White fat cells in adults are unilocular, that is, they have a single large cytoplasmic lipid droplet, which is not membrane-bound. The nucleus in these unilocular fat cells is peripheral and flattened. In cold conditions or starvation the lipid is mobilized and degraded as a source of energy.
92. $a - b + c - d + c + e +$
 Brown fat cells are multilocular, that is, they have many small cytoplasmic lipid droplets in each cell. Brown fat cells are less commonly found than white fat cells and are restricted mainly to fetuses or to a limited number of sites in the first years after birth. Some mammals, especially those that hibernate, have quite abundant brown fat reserves. Norepinephrine liberated by nerve activities lipases present in adipose cells and promotes the hydrolysis of the lipids.
93. $a - b + c + d + e +$
 In normal wax-embedded hematoxylin and eosin stained preparations, lipids are lost, partly during the dehydration, but mainly in the clearing agents such as xylene that are used in the wax-embedding. The sites where the lipid has been dissolved are presented by clear spaces. It is possible to preserve and stain lipids in tissues by making frozen sections and staining with dyes such as oil-Red-O. These preparations need to be mounted in water soluble mountants. Lipids can also be preserved in material that is fixed directly in osmium tetroxide.
94. $a - b - c + d + e +$
95. $a - b + c - d + e +$
 Mast cells are connective tissue cells that contain abundant basophilic granules that stain metachromatically with basic aniline dyes such as toluidine blue. The granules contain acid or neutral polysaccharides in association with proteins. The granules contain the anticoagulant, heparin, and also histamine, which affects the permeability of capillaries and mice mast cells also contain serotonin (though in humans serotonin is not found in mast cells). Mast cells play a role in the immunological response to allergens.
96. $a + b + c - d - e -$
 Histiocytes are fixed macrophages and originate from monocytes.

97. $a + b - c - d + e -$

98. $a - b + c + d + e -$

Plasma cells can be identified by their nuclei, which are displaced from the centre of the cells and by their strongly basophilic cytoplasmic reticulum and free ribosomes. Plasma cells are found throughout connective tissue and in areas of chronic inflammation or areas subject to penetration by microorganisms such as the area of the intestinal mucosa. In normal circumstances plasma cells are not found in the peripheral blood. The plasma cells are responsible for the synthesis of antibodies (humoral immune response).

99. $a + b + c + d - e -$

The Mononuclear Phagocyte System (MPS) involves all macrophages derived from monocytes. This includes the dust cells of the lungs, blood monocytes and Kupffer cells (though there is still a certain degree of controversy if Kupffer cells in fact originate from monocytes). The function of all the cells of the MPS is to remove foreign particulate bodies from the body and to act as cleansing agents.

100. $a - b + c + d + e +$

Mucous connective tissue is a special sort of connective tissue present only in fetuses. It contains fibroblasts, which secrete a jelly-like inter-cellular substance and collagenous fibers. Mucous connective tissue is well seen in the umbilical cord, where it is sometimes referred to as 'Wharton's Jelly'. It is also found in the pulp of young teeth.

101. $a + b + c + d - e +$

102. $a + b - c + d - e +$

Tendons belong to the regular dense connective tissue. They are found at the origin and insertion of skeletal muscles and connect the muscle to bones. When fresh, tendons appear white and they are resistant to stretching. In histological preparations tendons are seen to be composed of parallel bundles of collagen fibers with rows of fibrocytes situated between the bundles.

103. $a + b - c + d + e +$

Dense regular connective tissue is found in ligaments, the cornea, the dura mater, and in the tunica albuginea of the testis.

104. $a - b - c + d + e +$

Aponeuroses are flattened sheets of connective tissue that connect flattened muscles at their origin or insertion to bones. In histological structure they are indistinguishable from tendons.

105. $a + b - c - d + e +$

Ligaments connect bones to bones. Ligaments are usually fibrous and in histological structure are similar to tendons. In some cases such as the ligamentum nuchae or ligamenta flava, they may contain considerable amount of elastin and are in such cases referred to as 'elastic ligaments'. The main function of ligaments is to prevent excessive movements in joints.