Brief Review of Lab Material

Key Structural Features of Cells and Tissues

1. Epithelium: Sheets of cells, little space between adjacent cells

a) Simple squamous--one layer of flattened cells, each < 5 μm thick with flattened nucleus.

b) Simple cuboidal--one layer of cells; height approximately same as width, about 15 μm. Nucleus is usually round.

c) Simple columnar--one layer of cells; height greater than width, over 20 μm tall. Nucleus is usually oval.

d) Stratified squamous--several layers of cells, outer layer flattened. If no nuclei in outer layers, it is keratinized (skin). Usually quite thick, often over 100 μm.

e) Stratified cuboidal--at least two layers of cells, outer layer of cells has height approximately the same as width.

f) Stratified columnar--at least two layers of cells with outer layer of cells quite tall (over 20 μm).

g) Pseudostratified columnar--all cells touch basal lamina, most cells touch lumen. Look for two layers of nuclei--one layer of oval nuclei belongs to columnar cells, second layer of rounded (or sometimes flattened) nuclei near basal lamina belongs to basal cells.

h) Transitional--at least two layers of cells. Outer layer contains large, polygonal cells with lots of cytoplasm between nucleus and lumen. Outer layer of cells often has "pillowy" appearance, as cytoplasm bulges into lumen.

2. Connective Tissue (CT): Cells embedded in an extracellular matrix of fibers and ground substance. Usually large extracellular spaces between cells. Common cell types: fibroblasts (long, spindle-shaped cell with elongated nucleus), plasma cells (ovoid cell, 20 μm, eccentrically located “clockface” nucleus), mast cells (ovoid cell with round nucleus and many granules in cytoplasm), lymphocytes (small round cell, 8 μm in diameter, dark round nucleus and scant cytoplasm), neutrophils (round cell, 12 μm in diameter, multi-lobed nucleus, pale cytoplasmic granules), eosinophils (round cell, 12 μm in diameter, bi-lobed nucleus, red cytoplasmic granules), basophils (round cell, 12 μm in diameter, blue cytoplasmic granules).

a) Connective tissue proper--fibroblasts surrounded by extracellular collagen fibers. Loose CT--few fibers, many cells. Dense CT--many fibers, relatively few cells. In dense, irregular CT, fibroblasts have random orientation.

b) Adipose tissue--main component = fat cells. Unilocular fat contains large (20-40 μm) round cells, usually very palely staining, due to loss of intracellular fat during tissue preparation. Nucleus often flattened at one side of each cell. (Note: each pale staining opening has at most one nucleus, as opposed to blood vessels where a similar sized opening would be surrounded by several endothelial cells).

c) Cartilage--chondrocytes surrounded by matrix. Chondrocytes often shrink during specimen preparation leaving holes (lacunae) in matrix. 3 features to look for: (1) perichondrium--layer of oriented fibroblasts and collagen at edge of cartilage, (2) "nests" of chondrocytes representing interstitial growth, (3) difference in staining of matrix near lacunae (territorial matrix). No blood vessels in cartilage.

d) Bone--osteocytes surrounded by bone matrix. There is no interstitial growth in bone, so no groups or nests of cells as in cartilage. Bone contains blood vessels.

3. Muscle: --fibrous tissue--cells are elongated.

a) Smooth muscle--cells typically 5 μm by 20 to 50 μm. Nucleus is in center of cell. In cross section, each cell has circular profile and, since cell is much longer than nucleus, only about 20% of cells have nucleus in plane of section. In longitudinal section, smooth muscle can be distinguished from collagen by several criteria--in smooth muscle: fibers are more regularly oriented, nuclei tend to be oriented in one direction, there are more nuclei per unit area, and nuclei are inside fiber.

b) Skeletal muscle--cells about 50 μm wide and thousands of μm long. Nuclei are found at the edge of the cell. Note regular A/I banding pattern (2.5 μm) in longitudinal sections. Cell rounded or polygonal in cross section--look for nuclei at edge of cell.

c) Cardiac muscle--cells typically 20 μm by 80 μm. Have A/I banding. Nuclei are found in the center of cell. Contrast with skeletal muscle by smaller dimensions, position of nuclei, and presence of intercalated disks at ends of fibers. **(Cardiac muscle is NOT on the Molecules, Cells, and Tissues final, but will be covered in Normal Body)**

4. Nervous Tissue: Nerve cells and supporting cells. Be able to recognize nerve axons in peripheral nerves and neuronal cell bodies in the CNS and in ganglia.

a) Peripheral nerves--fibrous tissue. "Fiber" consists of axon and myelin sheath. In longitudinal section, fibers appear "wavy". Often have "dull" appearance due to presence of myelin, as apposed to "shiny" appearance of smooth muscle. In cross section look for axons surrounded by palely staining myelin sheath. Nerve can also be distinguished from CT or muscle fibers by presence of perineurium surrounding

bundle of axons. Perineurium consists of one or more layers of flattened cells--this structure is unique to nervous tissue.

b) Neuronal cell bodies--in ganglia or in CNS. Nucleus is often round, extremely large (about 20 μm), lightly staining, with prominent nucleolus. Cell body often surrounded by "satellite" cells--glial cells with smaller (5-10 μm), round, darkly staining nuclei.