Disclaimer

Cannot summarize the entirety of Histology and Cell Biology in one lecture, so the following is a review on the really basic and material not covered (well) in class.
Histology - General

Sample Prep:
- Tissue specimen is collected and formalin fixed and paraffin embedded to preserve structure from degradation (takes 12+ hours).
  - Rapid processing is when tissue is fixed in glue and frozen (20 min).
- Tissue is then sectioned on a microtome (4 μm) and then stained.

H&E Staining:
- Hematoxylin stains nucleic acids/ER blue, Eosin stains elastin/collagen/reticular fibers pink.
- The fixing and staining processes ALWAYS dissolves fats, these are not visible on sections and are holes in the tissue.
Other Staining

- Masson’s Trichrome – Stains collagen
- Giemsa – Stains blood cells
- Periodic acid–Schiff stain – Stains glycolipids purple
Cell Biology - Cell Structure

Rough ER: Synthesizes secretory proteins, and exports these by budding through transfer vesicles that is received by Golgi. ALSO for N-linked oligosaccharide addition

Smooth ER: Synthesizes steroids, TAG, Cholesterol
- Phenobarbital stimulates SER production and catalyzes drug detox through oxidases.
- High in hepatocytes and adrenal cortex

Annulate Lamellae: Parallel stacks of the nuclear envelope with pores to allow passage of mRNA to ER for transcription.

C=Cristae, M=Matrix, MG=matrix granules
N=nucleioid within peroxisome
Meiotic Replication – Prophase I

- Pachytene begins as soon as the synapsis is complete and includes the period of crossover
Cell Injury and Death

Know the histological difference between apoptosis, autophagy, and necrosis!

Apoptosis
- Cell Shrinkage
- Membrane Blebbing
- Nuclear Fragmentation
- Massive Vacuolization
- Protein Degradation
- Loss of Organelles

Autophagy
- Autophagosome Formation
- Autophagosomal-Lysosomal Fusion
- Cytoplasmic Vacuolation

Necrosis
- Cell Swelling
- Damaged Organelles
- Plasma Membrane Rupture
- Cell Lysis
Histology – Epithelium

Where are these found and why?
Bullous pemphigoid (BP): BP antigen causes the separation of the epithelium from the basal lamina.

Pemphigus vulgaris: Causes autoantibody to desmogleins and results in blistering.
Histology – Epithelium/Nervous System

Sensory Corpuscles – Pacinian
- Large encapsulated nerve ending
- In deep skin layers, joints, serous membranes, and mesenteries
- Pressure, coarse touch, vibration and tension.

Meisnner’s Corpuscle
- Small, encapsulated nerve endings
- Dermis of palms, soles, digits (hairless skin)
- Light discriminatory touch
Histology – Epithelium/Nervous System

A: Merkel disk  B: Meisner corpuscle  C: Pacinian Corpuscle  D: Free nerve ending (nociceptor/thermoceptor)
E: Ruffini corpuscle  F: Krause end bulb (cold receptor)  G: Neuromuscular Spindle  H: Golgi Tendon Organ
Serous glands secrete a watery fluid like, often protein-rich product. e.g. sweat gland.

Mucous glands secrete a viscous product, rich in carbohydrates (e.g., glycoproteins). goblet cell.

Sebaceous glands secrete a lipid product. These glands are also known as oil glands. pancreas, gastric gland.
Histology - Connective Tissue

Fibroblasts – Mesenchymal and are most common in CT.
- Contain oval nucleus with two or more nucleoli.
- Divide only during wound healing, also differentiate into adipose or cartilage.

Collagen
What is Collagen?

• Most abundant protein in body
• Organizes, strengthens extracellular matrix

Type I
• Bone, skin, tendon, dentin, fascia, cornea

Type II
• Cartilage, vitreous body, nucleus pulposus

Type III (Reticulin)
• Skin, blood vessels, uterus, fetal tissue

Type IV
• Basement membrane

Ehlers-Danlos Type IV Syndrome: Defective Type III collagen gene producing skin that is thin, translucent, fragile, and easily bruised
Histology - Cartilage/Bones

C=chondrocytes  P=Perichondrium  CP=chondrogenic  Perichondrium  M=Matrix

ICL=Inner circumferential laminae  O=osteocyte  HC=Haversian Canal
Histology - Muscle
Histology – Nervous System

P = Purkinje Cells
ML = Molecular Layer
GL = Granular layer of cerebellum
Histology – Hematological
Lymphoid Tissue

Spleen:
Capsule (C).
Divided into a red pulp (RP) and white pulp.
Lymphoid nodule with a germinal center (GC) has B cells.
The lymphoid nodule is invested by the T-cell-rich region of the spleen, known as the periarterial lymphatic sheath (PALS).

Lymph node: Has cortex, paracortex, and medulla
Histology - Endocrine

Pars distalis of the adenohypophysis:
This is a trichrome stain.
Basophils are blue
Acidophils are red
Chromophobes are clear (Melanotroph)

Parathyroid – (F) Follicular cells, (M) mitochondria, (G) granules
References

All Pictures and information obtained from:

BRS Cell Biology and Histology

Histology and Cell Biology – USMLE Review Lecture by Rhys Brooks

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Slide 1:
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Slide 2:
Other stains need to know for Step 1 are:
- Masson’s Trichrome – Stains collagen (useful for liver pathology)
- Giemsa – Stains blood cells (useful for hematology)
- Periodic Acid/Shiff Stain – Stains glycolipids purple (also useful for liver pathology)

Slide 3:
Rough ER: Synthesizes secretory proteins, and exports these by budding through transfer vesicles that is received by Golgi. ALSO for N-linked oligosaccharide addition
Smooth ER: Synthesizes steroids, TAG, Cholesterol
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Annulate Lamellae: Parallel stacks of the nuclear envelope with pores to allow passage of mRNA to ER for transcription.

Slide 4:
- Important to recognize here the various stages of prophase I in meiosis, specifically that pachytene begins as soon as the synapsis is complete and includes the period of crossover

Slide 5:
Know the histological difference between apoptosis, autophagy, and necrosis!

Slide 6: Know the methods of Cell-Cell communication
- **A**=Zona occludens (tight junction)
  - Creates semi-permeable barrier
- **C**= Macula adherens (desmosome)
Slide 7:
Note here that there are various forms of blistering diseases that are the result of various defects in cell-cell communication, not just desmosomes!

Slide 8/9:
Know the various nerve endings found in epithelial cells and what information they convey.

Slide 10:
Recognize the structure and function of the various ducts throughout the body and how to describe them on a histological section.

Slide 11:
Note the histology of collagen, the lineage of fibroblasts, and that they only divide under injury or stress.

Slide 12:
Recognize the various types of collagen, what tissues they comprise, and the various different disorders related to their deficiency/mutation.

Slide 13:
Hyaline cartilage is the most abundant cartilage in the body, and it also serves as a temporary skeleton in the fetus until it is replaced by bone and has type II collagen.
Perichondrium: Blood supply to avascular cartilaginous tissue.
Chondrocytes mature supporting cells

Slide 14:
Recognize the different appearance of muscle depending on the section. Note the nucleus shape, size, and mitochondria.
LS= Longitudinal Section of Muscle
CS= Cross section of Muscle

Slide 15:
Astrocyte: Physical support and repair of axons
  K+ metabolism
  Maintain blood-brain barrier
Slide 16:
Light micrograph of a cross section of a human rib displaying its bone marrow.
B, bone; M, megakaryocytes; ARC, adventitial reticular cells; arrow, endosteum.
Light micrograph of an artery and vein.
Vein-lumen (LV), tunica media (TMV), and tunica adventitia (TAV).
Artery-tunica adventitia (TAAI, tunica media (TMAI, and lumen (LAI

Slide 17:
Neut (Normal, hyper seg), Mast cell->Eosin, Basophil->Plasma
Neutrophils: Multilobed nucleus
  Mediate acute inflammatory response
  Phagocytic
  Primary granules contain hydrolytic enzymes, lysozyme, myeloperoxidase
  Hypersegmented in B12/folate deficiency
Mast Cells: Mediate allergic reaction
  • Contain histamine, heparin, chemotactic factors
  • Bind IgE to cell membrane
Found in tissue
Cromolyn sodium prevents degranulation

Slide 18:
Know the histology of lymphoid tissue, where T/B cells are located, and the direction of lymph flow

Slide 19:
Recognize which hormones are produced by acidophils, basophils and chromophobes. Be able to distinguish these on H&E stain.