Lymphatic Tissue
Lymphatic tissue produces lymphocytes that protect the body from foreign macromolecules and screen the circulating body fluids (blood and lymph) for abnormal or foreign components. Some lymphatic tissue is located in encapsulated lymph nodes, small, bean-shaped organs along the route of lymphatic vessels. Other unencapsulated lymphatic tissue is associated with body passages (gastrointestinal, urinary, respiratory) either as diffuse arrays of lymphocytes in the lamina propria of organs or as lymphatic nodules or lymphatic follicles.

1. Lymph nodes:
Slide 76
Ross et al. p. 417, Fig. 14.18; Plates 33, 34

Lymph nodes are small encapsulations of lymphatic tissue that are scattered throughout the body. Lymph nodes are surrounded by a collagenous capsule. Reticular tissue, produced by reticular cells, contains reticular fibers and forms the supporting meshwork of the lymph node. Lymph enters the lymph node via afferent lymphatic vessels and exits in an efferent lymphatic vessel at the hilum - a small indentation on the surface of the lymph node (see Fig. 14.18). The lymphatic vessels have valves to guarantee unidirectional flow of lymph. The lymph is delivered into a space underlying the capsule called the subcapsular sinus. The cortex of the lymph nodes consists of both dense lymphatic tissue and sinuses (channels carrying lymph). The cells in the lymphatic cortex are primarily lymphocytes (T and B lymphocytes). The B lymphocytes aggregate into nodules. If the follicle has a pale (H&E) center, it is called a secondary follicle. If the pale area is not present, it is a primary follicle. The pale area in the center of secondary lymphocytes is the area where B lymphocytes are formed, and is called the germinal center. Primary follicles are probably inactive secondary follicles. The deep layer of the cortex consists mainly of T lymphocytes, but follicles may also be found here, particularly in immunologically active lymph nodes. The medulla of the lymph node contains medullary sinuses. These are bordered by bundles of B-lymphocytes and plasma cells (antibody-secreting B lymphocytes).

2. Palatine Tonsil:
Slide 75
Ross et al. p. 415, Fig. 14.16; Plate 32

The tonsils guard the opening to the gastrointestinal and respiratory systems. Palatine tonsils are large, unencapsulated masses of lymphoid tissue in the lateral part of the oropharynx. The luminal surface of the tonsil is covered with a stratified squamous epithelium, which projects very deeply into the tonsil, forming blind crypts. The crypts are lined with lymphoid tissue that contain lymphoid nodules.
3. Thymus:
Slide 46
Ross et. al. p. 421-422, Figs. 14.24 and 14.25; Plate 37

The thymus is responsible for the initial maturation and proliferation of the lymphocytes that are involved in cell-mediated immune responses (T lymphocytes). It is surrounded by a connective tissue capsule, and consists of several lobes separated by connective tissue septa. Each lobe contains an outer dense cortex, and an inner paler staining medulla. The free cells of the thymus are contained in a network of reticular cells and fibers. The cortex constantly produces lymphocytes, which represent the majority of the cells in the cortex. From the cortex, the lymphocytes migrate to medulla where they enter the bloodstream through postcapillary venules. The most prominent feature of the thymic medulla is Hassall's or thymic corpuscles. These are composed of flattened epithelial reticular cells arranged in concentric layers. The medulla of the thymus is the only place that Hassall's corpuscles are found.

4. Spleen:
Slides 72, 73, 74
Ross et. al. p. 426-428, Figs. 14.29, 14.30 and 14.31; Plate 35, 36

The spleen is positioned in the cardiovascular system to filter blood, destroy abnormal and damaged blood cells, degrade hemoglobin, store erythrocytes, and participate in immunological responses. It is surrounded by a dense connective tissue capsule, with connective tissue trabeculae penetrating into the lymphatic tissue. The spaces between the trabeculae contain a network of reticular cells and fibers. The splenic tissue is divided into white pulp and red pulp; in H & E staining, the white pulp is stained blue, darker than the red pulp. The white pulp contains lymphatic tissue and is associated with the arterial blood supply to the spleen. The lymphoid tissue forms periarterial lymphatic sheath (PALS) that surround the central arteries. The red pulp contains a reticular network that is full of blood. Within the red pulp are large, thin-walled blood vessels called splenic sinuses separated by splenic cords (cords of Bilroth), containing macrophages, reticular cells, and blood cells.

5. Lymphatic tissue and Nodules:
Slides 21-23, 25, 26
Ross et. al. p. 413, Fig. 14.13, 14.14, p. 416 Fig. 14.17; Plates 57.1, 59, 60, 67.2, 68.2

Lymphatic tissue is also distributed along the respiratory and gastrointestinal tract as loose populations of lymphocytes or lymphatic nodules. Take a look at some of these slides and see if you can identify the lymphatic tissue. In particular, be sure to identify Peyer's patches in the wall of the ileum of the small intestine.

Reproductive System

6. Ovary and Oviduct:
Slides 35, 66
Ross et. al. Plates 88, 89
The ovary is composed of a cortex and medulla. The medulla, in the center of the ovary, contains loose connective tissue, blood and lymphatic vessels, and nerves. The cortex is coated by a single layer of epithelial cells called the germinal epithelium. Beneath the germinal epithelium is a layer of dense connective tissue, the tunica albuginea (TA). Interior to the TA are the ovarian follicles at different stages of development; the larger follicles tend to be more developed. Primordial follicles are composed of an oocyte surrounded by a single layer of squamous follicular cells. A primordial follicle develops into a primary follicle by proliferation of the follicular cells that assume a cuboidal shape and become known as granulose cells. Neighboring the follicular layer is an eosinophilic layer called the zona pellucida. Connective tissue cells outside the basal lamina proliferate to form 2 cellular layers: the internal theca interna (steroid producing) and the theca externa (smooth muscle and connective tissue cells). As the granulosa cells proliferate and produce a thickness of 6-12 cell layers, fluid-filled cavities appear eventually forming one fluid-filled cavity— the antrum. The appearance of the antrum identifies the follicle as a secondary follicle. Other follicles, atretic follicles, are undergoing degeneration or atresia (Plate 89); often all that remains is the zona pellucida. The mature follicle is called a Graafian follicle; it has a width equal to that of the ovarian cortex and causes the surface to bulge. After ovulation, the remaining granulose cells and the theca interna cells differentiate to form a corpus luteum. The membrana granulose becomes folded (plicated) filling the vacated cavity with steroid-producing granulose lutein cells. In addition a number of capillaries arise and spaces are filled with theca lutein cells (formerly cells of the theca lutein). The uterine (Fallopian) tubes carry the oocyte from the ovary to the uterus after ovulation and provide a supportive environment for fertilization and the initial development of the ova. The mucosa is extensively folded and the simple columnar epithelium consists of both ciliated and nonciliated (peg) cells. The height of the epithelial cells and the relative numbers of cilated and peg cells vary during the menstrual cycle. Beneath the mucosa is a smooth muscle mucularis with inner circular and outer longitudinal layers covered by a serosa.

7. Uterus and Cervix:
Slide 69
*Ross et. al. Plates 92, 93, 94*

The uterine wall consists of three layers. The endometrium (the mucosa) is the innermost layer, lining the uterine cavity. The middle layer is a thick smooth muscle, myometrium, that is surrounded by the thin outer serosa called the perimetrium. The endometrium, of simple columnar cells, changes in structure during the menstrual cycle. In the endometrium, the stratum functionale is lost every month in the absence of pregnancy while the underlying stratum basale is maintained. The stratum functionale contains glands as well as numerous blood vessels. The myometrium thickens by hypertrophy of muscle cells during pregnancy. The cervix is lined by a simple columnar epithelium (endometrium) with mucous glands that transitions to a stratified squamous epithelium where the cervix projects into the vagina.

8. Testes:
Slide 65
*Ross et. al. Plates 82*

The testes are covered with a thick dense connective capsule, the tunica albuginea (TA) lined
with a layer of loose connective tissue and blood vessels called the tunica vasculosa. Connective tissue septa divide the testes into lobules, each containing several seminiferous tubules. The seminiferous tubules are convoluted resulting in several different sectioned profiles. In septa between seminiferous tubules are found Leydig cells that produce testosterone. The epithelium lining the seminiferous tubules consists of several cell types including Sertoli cells as well as spermatogonia, spermatocytes and spermatids in the process of developing into sperm. Sertoli cells are the true epithelial cells and are tall and columnar. They support developing sperm that attach to the apical surface of the Sertoli cells (see Figures 22.6 and 22.13).

9. Vas Deferens (Ductus Deferens):
   Slide 60
   Ross et. al. Plates 85

The vas deferens is an extension of the epididymis transporting sperm from the testis. The mucosal layer is pseudostratified columnar epithelium with apical stereocilia; the lumen is often irregular rather than circular. Beneath the epithelium is a thick lamina propria. The wall of the vas deferens contains three thick smooth muscle layers, two longitudinal layers bordering an inner layer of circular muscle.