ENDOCRINE SYSTEM

The endocrine system, the nervous system and the immune system are the main control/regulatory systems of the body. Together they are responsible for maintaining a balance within the body of functions and chemical composition of fluids (homeostasis). Interactions between the three are numerous.

Endocrine cells act by secreting chemical messenger substances (hormones) into connective tissue spaces and adjacent blood capillaries, which carry the substances often to distant target organs. Endocrine cells are found in three distinct anatomic distributions: 1) gathered together in one specialized organ as an endocrine gland (e.g., pituitary, adrenal glands), 2) forming discrete clusters in another specialized organ (e.g., pancreatic islets), and 3), dispersed widely among the lining epithelial cells of certain organs, particularly the gut and respiratory tracts, as the diffuse neuroendocrine system (e.g., G cells of gastric mucosa).

In this laboratory we concentrate on the first category, the major endocrine glands. Note that these glands, unlike exocrine glands, are ductless and very richly vascularized, often with fenestrated capillaries. Think about why they might be fenestrated.

PITUITARY GLAND (hypophysis)

Recall that this gland has a dual embryonic origin: oral cavity ectoderm (Rathke’s pouch) and neuroectoderm (hypothalamic infundibular process). The former gives rise to the adenohypophysis (anterior lobe), the latter to the neurohypophysis (posterior lobe). The secretions of the two are remarkably different in origin and function.

The anterior pituitary (pars distalis) is largely composed of blood sinusoids (which are the second capillary bed in the hypothalamo-hypophyseal portal system), and the characteristic secretory cells: acidophils, basophils, and chromophobes. Acidophils release growth hormone and prolactin. Basophils release ACTH, TSH and the gonadotrophins. Chromophobes are non-secreting and may represent a pool of reserve cells.

The posterior pituitary (pars nervosa) is the terminus of the hypothalamo-hypophysial tracts. These nerve fibers store neurosecretory substance (Herring bodies). Most of the nuclei in this region are those of specialized glial cells (“pituicytes”).

THYROID GLAND

The secretory cells of this endocrine gland also are of two different embryonic origins. The thyroid is unusual in that the precursor of its major secretory products, tetra iodothyronine (thyroxine, T\textsubscript{4}) and triiodothyronine, (T\textsubscript{3}) are stored extracellularly in large quantity until needed. Be familiar with the biosynthetic and release pathways for these hormones.

The thyroid gland is composed of follicles. These are epithelial parenchymal cells surrounding a central storage vacuole. The storage material is a highly eosinophilic secretory product called colloid. The colloid consists mainly of thyroglobulin (a protein). This is the storage form of the hormones T\textsubscript{3} and T\textsubscript{4}. The size
of the follicles varies with the physiological activity of the gland as well as with the plane of histologic sectioning. The follicular epithelial cells are mostly cuboidal. In general, the higher the epithelium the greater the activity of the gland. When colloid is actively being processed to release thyroid hormone, there are “reabsorption lacunae” (see drawing above), indicating an active follicle.

**Parafollicular ("C") cells** may occur singly among the follicular epithelial cells, inside the follicular basal lamina but not making contact with the colloid. They also may occur in clusters outside the follicles. These cells secrete a hormone that lowers blood levels of calcium.

The thyroid has a relatively delicate capsule of fibroelastic connective tissue, which penetrates between the follicles to form the stroma of the gland. Typical of endocrine glands, the stroma is well vascularized.

**PARATHYROID GLANDS**

The parathyroid gland consists mostly of closely-packed cords or clumps of small, basophilic, secretory chief (principal) cells. The gland has a connective tissue capsule of its own. Connective tissue stroma is minimal but contains many blood capillaries. There are also clusters of larger, eosinophilic oxyphil cells. These cells usually do not appear until after puberty, and increase in numbers with age.

**ADRENAL (SUPRAARENAL) GLANDS**

These are endocrine glands with two structural/functional components of different embryonic origins: cortex-mesoderm, medulla-neural crest. Review their gross anatomical location and blood supply.

The adrenal gland has a connective tissue capsule, which surround a cortex and medulla. The cortex is divided into zones, distinguished by the organization of cells. From outer to inner: zona glomerulosa, zona fasciculata, zona reticularis.
LAB#6: ENDOCRINE; LYMPHOID TISSUE; REPRODUCTIVE SYSTEM

(see figure). There are intervening blood sinusoids. The zona glomerulosa is mostly making aldosterone; the fasciculate is mostly making glucocorticoids and the reticularis is mostly making sex hormones.

The parenchyma of the medulla is mostly comprised of chromaffin cells (modified sympathetic ganglion cells), with intervening blood sinusoids.
Arterial blood enters the gland in the capsule
The medulla has a dual blood supply:

- Medullary arterioles traverse the trabeculae of the cortex bringing arterial blood directly to the medulla
- Arterial blood first percolates through the cortex and drains into medullary capillary sinusoids exposing the medulla to high levels of steroid hormones (glucocorticoids are necessary to induce the enzyme methyltransferase, essential for the conversion of norepinephrine to epinephrine).

Venous drainage is from a single vein that drains from the medulla.

PANCREATIC ISLETS (of Langerhans)

The endocrine cells of the pancreas are aggregated into small, spherical clusters known as islets (of Langerhans), which are scattered among the exocrine acini and ducts. The cells of the islets are arranged into compact anastomosing cords that are extensively vascularized by fenestrated capillaries. In contrast to the exocrine pancreas, there are no ducts associated with the islets. Each islet cell is closely apposed to a capillary so that the hormones are released directly into pericapillary spaces.

Alpha and beta cells represent 20 and 75 percent of the islet cell population respectively. Alpha cells produce glucagon and beta cells produce insulin. There are a smaller number of somatostatin secreting delta cells and clear cells without stainable granules. Another islet cell type located preferentially in the head region secretes, in response to food ingestion, pancreatic polypeptide (PP), a hormone that stimulates gastric secretion while inhibiting bile secretion and intestinal peristalsis.

PINEAL

The pineal gland is an organ that is comprised of modified retinal cells (pinealocytes) and glial cells. The pinealocytes release melatonin into the circulation in a circadian fashion, under the control of the sympathetic nervous system. The most striking histological features of the pineal are the concretions surrounded by parenchymal cells of the pineal gland, known as pinealocytes, together with their supporting glial cells.
Understand endocrine, paracrine and autocrine secretory patterns.

PITUITARY GLAND: Know the embryonic origin of the anterior lobe (Rathe’s pouch) and the posterior lobe (neuroectoderm). Understand the difference in the cellular architecture, vasculature and the mode of secretion in the anterior and posterior pituitary. Identify:
- pars distalis (adenohypophysis, anterior pituitary)
  - basophils
  - acidophils
  - chromophobes
- pars nervosa (neurohypophysis, posterior pituitary)
  - pituicytes
  - Herring bodies (special stain only)
  - pars intermedia

THYROID GLAND: Understand the architecture of this gland and its stimulation, storage and release mechanisms. Understand what is meant by:
- follicles
- colloid (thyroglobulin)
- follicular cells
- reabsorption lacunae
- parafollicular (“C”) cells

PARATHYROID GLAND: Understand the architecture of this gland and its relationship to the thyroid gland. Know the physiological effects of the hormone secreted by the gland and its effect on calcium metabolism.
- chief (principal cells)
  - oxyphil cells

ADRENAL GLANDS: Understand the different embryonic origins of cortex and medulla. Know the structural/functional relationships and the hormones produced by each region.
- capsule
- cortex
  - zona glomerulosa
  - zona fasciculata
  - zona reticularis
  - blood supply
- EM of steroid-secreting cells
- medulla
  - chromaffin cells
  - blood supply

PANCREATIC ISLETS: Review the difference between endocrine and exocrine secretion in this mixed organ.
- alpha cells
- beta cells
IMMUNE (LYMPHOID) SYSTEM

The primary functions of the lymphoid organs (thymus, spleen, lymph nodes) are protective or immunologic in nature. These organs are the source of immunocompetent cells, which have the capacity to react with and neutralize foreign substances (antigens) to which the body may be exposed. Whether these substances are pathogens, such as bacteria and viruses or endogenous abnormal constituents, such as those found in tumors, the body can normally eliminate whatever foreign antigens are presented to it. Lymphocytes, plasma cells, and macrophages perform direct immunologic functions that effectively neutralize these antigens. Other cells, such as reticular cells and granulocytic white blood cells, perform more specialized ancillary functions in certain types of reactions. These cells and their precursors form the primary cellular populations of the lymphoid organs. The cellular population of any lymphoid organ is highly variable and largely reflects the organ’s functional role in the development of the immune system or its state of immune reactivity.

The term lymphoid system includes not only the cells within distinct (i.e., encapsulated) lymphoid organs but also the widely and more abundantly distributed lymphoid cells found in the peripheral circulation and in the loose connective tissue and epithelial tissues of various organs (e.g., gut, lung). The term immune system includes lymphoid cells and accessory cells, such as macrophages, and their secretory products (e.g., antibodies, cytokines, etc.).

PRIMARY (CENTRAL) LYMPHOID ORGANS

THYMUS

The thymus has a cortex and medulla (see below) and is partially divided into lobules by connective tissue septa derived from the gland capsule. Most of the cells (thymocytes) are small, immature T-lymphocytes. There are a few interspersed reticular cells, which are large cells having large pale staining nuclei. There is a blood-thymic barrier in the cortex. The barrier is formed by the continuous blood capillaries, reinforced by epithelial reticular cells and macrophages.

There are fewer cells in the medulla compared to cortex and the lymphocytes here are mostly immunocompetent but naive (virgin) T cells that have passed the selection process. The medulla is also more heterogeneous in appearance, containing in addition to lymphocytes many macrophages, “reticular cells”, abundant blood vessels and usually some thymic (Hassall's) corpuscles. The latter are balls of squamoid epithelial cells that are usually keratinized and often contain keratohyaline granules. They probably are formed from defunct reticular cells, but their function, if any, is still unknown.
In the adult thymus, the lymphoid tissue is substantially less abundant and is typically replaced by fibroadipose tissue. Most important for histological identification is the fact that Hassall’s corpuscles persist.

ENCAPSULATED SECONDARY (PERIPHERAL) LYMPHOID ORGANS

LYMPH NODE

A lymph node ("gland") is an encapsulated lymphoid organ. Afferent lymphatics enter a subcapsular sinus by penetrating the capsule. There are many macrophages stationed in this sinus and is a site where metastatic cells may be lodged and start to proliferate.

The cortex is divided into a superficial (containing lymphoid nodules) and a deep portion (paracortex). The superficial zone is “B cell-dependent”, since these cells represent a high proportion of the lymphocytes, while the paracortex has a predominance of “T cells”. Many of the active follicles of the superficial cortex have germinal centers (and are secondary follicles). The largest cells in these follicles are macrophages and follicular dendritic cells. These are antigen-presenting cells and in the cytoplasm of some of these cells there are small particles of foreign material (“tingible bodies”). The paracortex also contains unusual vessels, the high endothelial venules (HEV), which are the site where most circulating lymphocytes enter the node.

The medulla is characterized by medullary cords and sinuses. The sinuses contain lymph and transmit lymph toward the efferent lymphatics at the hilus. The efferent lymph vessels and blood vessels enter and leave the node at the hilus.

SPLEEN

The spleen has a capsule and trabeculae. Note that the largest trabeculae contain both arteries and veins whereas those of intermediate size contain only veins. There is scattered smooth muscles cells within the capsule and the substance of the trabeculae. The parenchyma of the organ is supported by a reticular cell stroma that provides support for the central regions of the spleen.

White pulp of the spleen is arranged so as to surround small (central) arteries thus forming a periarterial lymphatic sheath (PALS). The PALS is mainly populated by T cells. In places lymphoid nodules with germinal centers may develop next to the PALS, in which case the central artery appears eccentrically-located.
As in lymph nodes, these nodules are the focus of **B cells**. In the intervening red pulp (figure to right) you will see cellular strands, the **spleenic cords** (of Billroth) separating large, thin-walled **sinusoids**. These sinusoids have characteristic elongated endothelial cells ("**stave cells**") through which red blood cells and white blood cells in the parenchyma of the red pulp squeeze to enter the sinusoid. These then coalesce into veins.

**UNENCAPSULATED (aggregated and diffuse)**

**SECONDARY LYMPHOID TISSUE**

**TONSILS**

The **tonsils** (palatine, pharyngeal, and lingual) are incompletely encapsulated aggregates of lymphoid nodules that surround the entrance to the oral pharynx (tonsilar ring of Waldeyer). They are interposed in the path of both airborne and ingested pathogens. Not infrequently in young people they are "reactive" (enlarged) due to lymphocyte response to antigenic challenge. In the pre-antibiotic era surgical removal of chronically enlarged, inflamed tonsils was almost a routine office procedure. The epithelium covering the palatine tonsil is the stratified squamous, nonkeratinized epithelium of the oral cavity, while the pharyngeal tonsils ("adenoids") are covered by respiratory epithelium. The palatine tonsil has well-developed "**crypts**". The adenoids are located in the region of the auditory tubes and can block them when enlarged. This can lead to recurrent ear infections.

The substance of the tonsils is dominated by lymphoid nodules. The nodules are **B** cell domains, while the internodular zones are **T** cell dominated. Tonsils typically have efferent but no afferent lymphatic vessels.

**GASTROINTESTINAL TRACT**

There is extensive lymphoid tissue in the gastrointestinal tract to prevent invasion by the enormous numbers of bacterial located in the lumen. Much of this tissue is located in the lamina propria of the mucosal layer of the GI tract and has been termed **GALT** (gut-associated lymphoid tissue). In some areas (particularly the ileum and appendix) this lymphoid tissue can appear as follicles. In the ileum these are termed the **Peyer's patches** located within the antimesenteric mucosa of the ileum. Lymphoid tissue is particularly prominent in the appendix (see figure to right).
Understand the role of each lymphoid organ and lymphoid tissue in the function of the immune system. Be able to distinguish these structures from one another.

THYMUS: Know the changes in the thymus with age. Identify and define:
- capsule
- cortex
- medulla
- connective tissue septa
- thymocytes
- reticular (epitheliocytes) cells
- Hassall’s (thymic) corpuscles
- blood-thymic barrier
- involuted thymus
- absence of follicles/germinal centers

LYMPH NODE (GLAND): The structure of a lymph node is complex. Study the diagram in the lab manual. Understand the flow of lymph and blood within the node. Identify and define:
- capsule, trabeculae
- subcapsular sinus, cortical sinus, medullary sinus
- hilum
- afferent and efferent lymph vessels
- superficial (outer) cortex, follicles with germinal centers, B lymphocytes
- follicular dendritic cells
- paracortex (inner cortex), T lymphocytes
- high endothelial venules (HEV)
- medullary cords-reticular cells
- macrophages
- plasma cells

SPLEEN: Recognize the importance of the spleen and the relationship of its structure to its functions. Identify and define:
- capsule, trabeculae
- red pulp
- white pulp
- splenic cords (of Billroth)
- central arteries
- sinusoids
- macrophages
- penicillar arteries
- reticular cells
- periarterial lymphatic sheath (PALS), T lymphocytes
- secondary follicles, germinal center, B lymphocytes

UNENCAPSULATED LYMPHOID TISSUE: GALT & MALT.
- Tonsils covered with stratified squamous epithelium
  - lymphoid nodules, B lymphocytes
  - internodular zones, T lymphocytes
  - ring of Waldeyer
  - crypts
- Appendix with epithelial crypts (no villi)
  - lymphoid nodules (may have germinal centers)
- Peyer’s patches
MALE REPRODUCTIVE SYSTEM

The male reproductive system consists of primary sex organs (testes) and secondary or accessory sex organs. The secondary organs consist of a series of genital ducts (ductules efferentes, epididymis, ductus deferens, ejaculatory ducts) and associated glands (seminal vesicles, prostate, bulbourethral) terminating in the organ of copulation, the penis.

TESTIS

The testis is surrounded by a thick connective tissue capsule, the tunica albuginea. The bulk of the parenchyma is comprised of coiled seminiferous tubules with a small amount of interstitial CT containing interstitial (Leydig) cells. The interstitial (Leydig) cells contain crystals of Reinke which are of unknown significance. The main function of the interstitial cells is in producing male sex hormones (under the influence of interstitial cell stimulating hormone/LH).

The seminiferous tubules contain several cell types. Sustantacular cells (Sertoli cells; nurse cells) can be seen in the ducts with their large pale nuclei and prominent nucleoli. These are important in maturation of sperm and respond to FSH. There are multiple stages of sperm production: spermatogonia, primary spermatocytes, spermatids, spermatozoa (see the figure below). Of what does the blood-testis barrier consist?

RETE TESTIS AND EPIDIDYMIS

The rete testis is comprised of ducts at the testicular mediastinum, into which connect the seminiferous tubules to the epididymis. The lining epithelium of the epididymis is of the pseudostratified columnar type and consists of two distinct cell types: tall principal cells covered with stereocilia and smaller, basal cells that rest against the basal lamina. Stereocilium are large, elongated microvilli, and therefore contain a core of actin filaments. They are non-motile. The stroma of the epididymis is comprised of connective tissue, smooth muscles, and blood vessels. The epididymis is a site of maturation of spermatozoa that must remain in this site for some time before becoming motile.
DUCTUS DEFERENS  
(Vas deferens)

The ductus deferens is a thick-walled tube consisting of three concentric layers: mucosa, muscularis, and adventitia. The lumen of the organ is relatively small. The mucosa is composed of a pseudostratified columnar epithelium with stereocilia (similar to the epididymis) and a thin lamina propria rich in elastic fibers, which generally causes the mucosa to form longitudinal folds. The muscularis is very robust and consists of three layers of smooth muscle. The inner and outer layers have a longitudinal orientation, the intermediate layer circular. The adventitia is continuous with the CT of the spermatic cord.

PROSTATE GLAND

The prostate is a compound tubuloalveolar gland with a fibromuscular stroma. The secretory epithelium is usually of the simple columnar or pseudostratified columnar type. There are numerous intraluminal lamellated concretions (corpora amylacea), which are a characteristic feature of this gland in older males.

SEMINAL VESICLE

The seminal vesicle is a highly folded, tubular gland, which primarily secretes fructose (and other components) into the seminal fluid (energy for sperm). The pseudostratified columnar epithelium contains tall, nonciliated columnar cells and short, round “basal cells” that rest on the basal lamina. These cells are apparently stem cells. The tall columnar cells have an abundance of rough endoplasmic reticulum and large secretory vacuoles in the apical cytoplasm. There is an abundance of smooth muscle, arranged in two layers deep to the epithelium.

PENIS

The majority of the penis is comprised of a dense connective tissue capsule (the tunica albuginea) surrounding three cylinders of erectile tissue: the two corpora cavernosa and the single corpus spongiosum containing the penile urethra. The erectile tissues consist of endothelium-lined sunuses that
can become engorged with blood. The dorsal portion of the outer connective tissue contains numerous blood vessels and nerves.

CHECK LIST

Understand the architecture of the testis, epididymis, vas deferens, prostate gland & penis. Know the structural/hormonal relationships of each organ.

TESTIS: Understand the arrangement of the seminiferous tubules. Define and identify:

- tunica albuginea
- mediastinum/rete testis
- head, body, tail of epididymis
- interstitial tissue

-spermatogonia
-(secondary spermatocytes)
-late spermatids
-Sertoli (sustentacular cells)

Know the morphology and stages of spermatogenesis, including the ploidy of each cell type. Define and identify:

- primary spermatocytes
- early spermatids
- spermatozoa
- blood-testis barrier

EPIDIDYMIS: Define and identify:

-pseudostratified principal cells with stereocilia
-basal cells

DUCTUS DEFERENS: Define and identify:

-pseudostratified columnar cells
-three muscle layers
-lamina propria with elastic fibers

PROSTATE: Recognize that the prostate is very glandular with a well-developed fibromuscular stroma. Look for lamellated concretions (corpora amylacea), a distinguishing characteristic of the prostate.

PENIS: Know the basis structure and relationship of the three cylinders of erectile tissue. Define and identify:

-tunica albuginea
-corpora cavernosa
-urethra

-glans penis
-corpus spongiosum
FEMALE REPRODUCTIVE SYSTEM

The human female reproductive system consists of **two gonads (ovaries)**, **two uterine tubes (fallopian tubes)**, the **uterus**, the **vagina**, and the **external genitalia**. (The **mammary glands**, sometimes considered with the female reproductive organs, were studied in the integument lab). The structure of these organs undergo important modifications in the various stages of reproductive life (puberty, pregnancy, menopause), and also shows cyclic variations depending on hormonal relationships between the hypothalamus-hypophysis and ovary during the period of reproductive activity.

**OVARY**

The ovary has a **surface (“germinal”) epithelium**, comprised of cuboidal cells. This is a misnomer in that it has nothing to do with production of gametes instead it is continuous with the mesothelium of the mesovarium. The epithelium sits on a dense connective tissue capsule, the **tunica albuginea**. The site of entry and exit of blood vessels is termed the **hilum**, with the blood vessels extending into the **medulla**. The medullary stroma is comprised of loose fibroelastic connective tissue with some smooth muscles cells. The **cortex** is between the medulla and the tunica albuginea. The cortical stroma consists of whorls of densely packed fibroblast-like cells.
In the cortex, the most prominent feature are the **ovarian follicles**. These take several types: **primordial, unilaminar primary, multilaminar primary, secondary, mature (Graafian)** (see the figure above). During pregnancy, the follicle will become a **corpus luteum**. This is comprised of **granulosa lutein cells** with surrounding **theca lutein cells**.

**UTERINE TUBE (oviduct, Fallopian tube).**

The wall of the oviduct consists of highly folded mucosa, a muscularis (inner circular, outer longitudinal layers of smooth muscle and a serosal layer. The epithelial layer varies between simple columnar and pseudostratified columnar and is composed mostly of **ciliated cells** with some interspersed non-ciliated **secretory (peg) cells**. The lamina propria consists of loose fibroelastic connective tissue.

**UTERUS**

The uterus is an organ with three basic layers: the **endometrium, myometrium** and a **serosa** (over most of the organ). Additionally, the **cervix** is somewhat distinct histologically. The endometrium is covered by a single layer of tall columnar epithelium that extends down to line the tubular glands that are surrounded by endometrial stroma.

In the **proliferative stage** the glands are relatively straight and lined by an epithelium that is uniform and shows no cytoplasmic signs of secretion. Numerous mitotic figures can be seen in the glandular epithelium because it is developing rapidly. The cuboidal cells are supported by a loose connective tissue that is also considered to be part of the endometrium, mainly consisting of fibroblasts, and blood vessels. The endometrial zone adjacent to the myometrium has a greater density of cells and constitutes the **stratum basale**. This stratum is not sloughed off during menstruation and serves to regenerate the endometrium. The stroma adjacent to the myometrium contains small arteries or arterioles that extend towards the uterine lumen. These are the **spiral arteries**. The superficial stroma of the endometrium is rich in and capillaries and venous sinusoids.

The **myometrium** consists of interlacing bundles of smooth muscle cells plus blood vessels and relatively sparse collagenous tissue. There are no distinct layers of smooth muscle.

In the latter (secretory; luteal) stage of the menstrual cycle (days 14-28) the endometrial glands of the stratum functionalis become coiled, irregular in diameter, and lined by columnar cells that show signs of secretion. The columnar cells lining the glands become larger and taller. It is this functional layer that will be sloughed during menses.
CERVIX & VAGINA

The cervix represents a transition from the body of the uterus to the vagina. The myometrium has many more connective tissue fibers and fewer smooth muscle cells. There is nonkeratinized stratified squamous epithelium covering the vaginal portion of the cervix (“ectocervix”). The endocervix surrounds the cervical canal and is lined by simple columnar epithelium continuous with the endometrium. There are well-developed cervical mucous glands in this region. Also, there is an abrupt change of stratified squamous to simple columnar epithelium near the external os of the cervical canal, the junction between endocervix and ectocervix. This region of epithelial transition is clinically important since it is here that many carcinomas of the cervix develop.

The vaginal wall consists of three principle layers: mucosa, muscle and adventitia. The vaginal mucosa, may be thrown into folds (rugae), lined by a stratified squamous, nonkeratinizing epithelium. The thickness of the epithelium varies with the stage of the reproductive cycle. The epithelial cells are rich in glycogen (thus, the “empty” appearance of these cells in routine histological preps), which serves as a metabolic substrate for the commensal bacteria of the vagina. The epithelium is supported by a loose to moderately dense fibroelastic connective tissue stroma with abundant venous and lymphatic vessels. Note the absence of mucous glands in the vaginal wall. The muscle layer consists predominantly of smooth muscle fibers, which run in spiral-like and longitudinal fashion through the wall. Skeletal muscle fibers from the perineal musculature may also blend with the wall in the region of the vaginal introitus.
Placental villi are attached to the chorionic plate and extend into the intervillosous space, surrounded by maternal blood that is entering from the decidua basalis, which is derived from maternal tissue along with placental septae.

The chorionic plate proper consists of rather dense vascular and connective tissue. In places on the fetal (non-villous) side of the plate there are amniotic cells.

The villi are initially covered by two layers, an inner one from cytotrophoblast and an outer one from syncytiotrophoblast (see the figure below). Later in pregnancy the cytotrophoblast layer is almost completely lost; only a few scattered cells or nests of cells remain in the term placenta. In these cases, the syncytiotrophoblast may be the only thing (other than a basement membrane) separating maternal blood from the endothelium of the fetal blood vessels in the core of the villi. Surrounding the blood vessels is irregular loose connective tissue. The CT within the villi contains a population of macrophages called Hofbauer cells. In addition to their customary role as part of the immune system, these cells may help to maintain villous homeostasis by affecting water regulation and nutrient/waste transport.

Mature villi are highly branched. The stem that is attached to the chorionic plate is the stem villus; the branches include terminal villi and anchoring villus.
CHECK LIST

Understand the general architecture of the ovary, uterus, cervix, uterine tube, vagina and placental villi.

OVARY: Understand the contents of the hilum, cortex and medulla. Know the cycle of maturation of follicles, including the ploidy of each stage. Know the location and secretory patterns of hormones affecting the ovary and secreted by the ovary. Identify:

- germinal epithelium
- tunica albuginea
- primordial follicle
- unilaminar primary follicle
- multilaminar primary follicle
- secondary (antral) follicle
- mature (Graafian) follicle
- corpus luteum
- corpus albicans
- granulosa lutein cells

UTERINE TUBE: Know the anatomical segments of the uterine tube. Identify:

- mesosalpinx
- lamina propria
- ciliated cells

UTERUS: Know the structure and function of the layers of the wall. Understand the morphology and endocrinology of the uterine (menstrual) cycle. Identify:

- myometrium
- endometrium
- stratum functionalis
- epithelium
- uterine glands
- spiral arteries
- stratum basalis
- lamina propria (stroma)
- lamina proplla (stroma)
- identify the progressive changes in endometrial structures during proliferative, secretory and menstrual stages.

CERVIX AND VAGINA: Know the epithelial transition region at the endocervix/ectocervix junction. Know the three layers of the vagina. Identify:

- cervical mucus glands
- epithelial transition zone
- epithelium of vagina

PLACENTA: Describe the basalis, capsularis, parietalis, chorionic plate. Identify:

- syncytiotrophoblast cells
- cytotrophoblast cells
- Hofbauer cells