Histology

Adrenal gland
Thyroid gland
Parathyroid gland
Pineal body, APUD cells
Thyroid gland (Figure 1)

- Embryologically, it derived from the cephalic portion of the alimentary canal (endoderm).
- It is located in the cervical region anterior to the larynx and trachea.
- Consists of two lobes connected by an isthmus.
- It is covered by C.T. capsule.
- Thyroid tissue is composed of microscopic spheres called thyroid follicles that are filled with gelatinous substance called colloid.
- Follicular wall composed of cells called follicular cells which range from simple squamous epi. to simple columnar epi. according to their activity.
- Follicular cells secrete the hormones thyroxin (T₄) and tri-iodo-thyronine (T₃).
- Between thyroid follicles there is loose C.T. contains parafollicular cells (c-cells) which are larger than thyroid follicular cells. They secrete calcitonin (influence serum Ca^{2+} level).
Parathyroid Glands (Figure 2)

- The parathyroids are four small glands with a total weight of about 0.4 gm (0.1 each).
- They are located behind the thyroid gland, one at each end of the upper and lower poles, usually in the capsule that covers the lobes of the thyroid.
- The parathyroid glands are derived from the pharyngeal pouches:
  > The superior glands from the fourth pouch
  > And the inferior glands from the third pouch.
  > Each parathyroid gland is covered by a connective tissue capsule.

There are two types of cells:

1. The chief cells: small polygonal cells with slightly acidophilic cytoplasm.

2. The oxyphil cells: fewer, larger, with coarse eosinophilic cytoplasm.

Parathyroid gland chief cells secrete parathormone which regulate serum Ca$^{+2}$. 
The Adrenal Glands (Figure 3)

Are paired, flattened, triangular organs that lie near the superior poles of the kidneys, embedded in adipose tissue. Together they weigh about 8 g, but their weight and size vary with the age and physiological condition of the individual. They are approximately 5x 4x 1 cm in diameter.

Histology:

Adrenal gland is enclosed by dense collagenous connective tissue. The stroma consists mainly of a rich network of reticular fibers that supports the secretory cells.

Suprarenal gland consists of 2 parts which are of different embryonic origin:

1. Cortex 90%: derived from the genital ridge of the
mesoderm.

2. Medulla 10%: derived from the neural crest cells.

**Adrenal cortex**

Because of the differences in disposition and appearance of its cells, the adrenal cortex can be subdivided into three concentric layers which not sharply defined in humans:

1. The *zona glomerulosa*

2. The *zona fasciculata*

3. The *zona reticularis*

Note: all cells of the cortex show ultra-structure of steroid-hormone-secreting cells.

**Zona glomerulosa:**

- This thin outer layer lies immediately beneath the connective tissue capsule.

- LM. examination shows that its cells are pyramidal cells and arranged in rounded or arched cords surrounded by capillaries.

- Their nuclei are rounded and central and cytoplasm is lightly basophilic.

- These cells secrete mineralocorticoids -mainly aldosterone-(controls electrolytes -Na⁺ & k⁺-hemostasis and water balance).

**Zona fasciculata:**
Thickest layer of the cortex.

**LM. features:**

- The cells of the zona fasciculata are polyhedral, with central rounded nucleus and pale foamy cytoplasm.
- The cells are arranged in parallel columns of one- or two-cell thickness and the columns run at right angle to the capsule.
- Their cytoplasm contains great number of lipid droplets that contain neutral fats, FAs, cholesterol and phospholipids. These substances represent precursors for steroid hormones.
- During slide preparation (BY typical histological procedures) lipid is extracted, so the fasciculata cells appear vacuolated (spongy appearance). Because of their vacuolization, the cells of the fasciculata are also called spongyocytes.

**Zona fasciculata cells secrete:**

1. glucocorticoids -mainly cortisone and Cortisol- which influence carbohydrates, fat and protein metabolism.
2. gonadocorticoids (sex hormones) -estrogen in females and androgen in males- in small amounts.

**The zona reticularis:**
• The innermost layer of the cortex, lies between the zona fasciculata and the medulla.

• It contains small rounded cells that are arranged in branching and anastomosing cords or columns.

• They have rounded central nuclei and deeply basophilic cytoplasm.

• It secretes gonadocorticoids mainly and small amount of glucocorticoids.

Adrenal Medulla

• The adrenal medulla is composed of polyhedral cells called medullary cells (also called chromaffin cells) arranged in cords or clumps surrounded by capillaries and supported by a reticular fiber network.

• Demonstrated 2 types of cells:

1. norepinephrine-secreting cells: have larger granules and more electron-dense secretory material (within the granules).

2. epinephrine-secreting cells: have smaller granules that contain less electron dense secretory products.

When medullary cells are exposed to an oxidizing agent such as potassium bichromate (K₂Cr₂O₇), catecholamines will be
oxidized giving a brown melanin-like compound. This reaction is called chromaffin reaction.

**Blood Supply to adrenal gland:**
1. Sup. suprarenal a. from phrenic a.
2. Middle suprarenal a. from aorta
3. Inf. suprarenal a. from renal a.

These arteries enter the gland at various points around their periphery. Later, they form sub-capsular plexus from which three groups of arteries arise;

1. Arteries that supply the capsule.
2. Arteries of the cortex, branch repeatedly to form capillaries that supply the gland cells of the cortex and that eventually reach the medullary capillaries.
3. medullary arteries, which pass through the cortex and form an extensive capillary network in the medulla.

♦ All capillaries later drain to the adrenal or suprarenal vein.

**Pineal body (Gland) (Epiphysis cerebri)**

- In the adult, it is a flattened conical organ situated on the roof of the 3rd ventricle.
- It derived from diencephalon.
• The pineal gland is covered by pia mater. Connective tissue septa containing blood vessels and un-myelinated nerve fibers originate in the pia mater and penetrate the pineal tissue, the septa divides the gland incompletely into lobules.

• lobules consist of 2 types of cells:

1. **pinealocytes:**
   - epi. cells, difficult to find in routine stains, it is best seen in sliver stain.
   - It has irregular shape with long branching processes that terminate (in bulbous endings) near blood vessels, the bulbous endings contain secretory vesicles.
   - Have a slightly basophilic cytoplasm and lobulated nuclei with predominant nucleoli
   - Cytoplasm filled with lipid droplets.
   - These cells produce **melatonin** which influences gonadal development particularly before period of sexual maturity.

2. **glial cells:**
   - Supporting cells that form a network interwoven between blood v. and around processes of pinealocytes.
   - Have small, elongated nucleus and cytoplasmic processes.
   - In addition to cells, human pineal body contains calcified concreoins (seen in x-rays) they are also called "brain strands", which are composed of calcium phosphate and calcium carbonate, they have irregular shape and lamellar appearance when seen in sectioned specimen.
   - Gland activity is influenced by changes in the external knighting (i.e.)

light entering the eye -> stimulate neurons -> impulse
transmitted to pineal body -> decrease secretion of melatonin. night time -> increase melatonin secretion 10 times than day time.

**APUD cells** *(Amine Precursor Uptake Decarboxylase)*

Constitute a group of apparently unrelated endocrine cells, which were named by the scientist **Pearse**, who developed the APUD concept in the early 60's. These cells share the common function of secreting a low molecular weight polypeptide hormone. There are several different types which secrete the hormones secretin, cholecystokinin and several others. The name is derived from ....

- **Amine** - for high amine content.
- **Precursor Uptake** - for high uptake of (amine) precursors.
- **Decarboxylase** - for high content of the enzyme amino acid decarboxylase (for conversion of precursors to amines).
(Figure 3)
(Figure 4)