Endocrine System: Anatomy and Physiology
Refer to: Text Chapter 18, Lab Manual and Endocrine Lab with related histology and YOUR OWN ENDOCRINE CHART.

Overview of Endocrine System:
You have already been introduced to the endocrine system and we have studied most of the endocrine glands in lecture and/or lab as we progressed through each system over the course of both semesters. Most of this will be a review, some will enhance your previous endocrine knowledge, and some of this will be new material. The endocrine system is an excellent way to pull the body and your overall knowledge of A&P together. This will also help you study for your required endocrine lab material—some of this is a repeat from your endocrine lab.

1. Distinguish between exocrine glands and endocrine glands.
2. Compare/contrast the regulatory mechanisms of the endocrine system to the nervous system.
3. Identify the major endocrine glands on a human model, diagram, or on the cat.
4. List the major endocrine glands, their hormones, and the functions of these hormones. Note disorders associated with high or low levels of the hormone. Develop a chart on your own—it will work well here.

Hypothalamus and Pituitary Gland:
- Study Lab Manual and Fig. 18.5(Text)
- What is the anatomical relationship between the hypothalamus, infundibulum, anterior pituitary, and posterior pituitary? What are their blood/neuronal relationships? Where are these structures located in the skull?
- What role does the hypothalamus play in regulating hormones of other endocrine glands via releasing hormones or inhibiting hormones?
- Why is the hypothalamus now considered the “master gland?”
- What is the function of the hypophyseal portal system? Be specific in its relationship to the hypothalamus and the Anterior Pituitary.
- What is the physical and neuronal relationship between the hypothalamus neurosecretory cells and the posterior pituitary gland?

Pituitary Gland Histology—Review from Lab
Identify these structures:
- Anterior pituitary
- Posterior pituitary
- Infundibulum (should be able to see on lab slide)
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Anterior Pituitary Gland
1. What role does the anterior pituitary play in regulating endocrine function?
   - Define tropic hormones.
     A. Adrenocorticotropic hormone (ACTH)
     B. Thyrotropic hormone (thyroid stimulating hormone, TSH, thyrotropin)

   - Define gonadotropic hormones.
     A. Follicle stimulating hormone (FSH)
        a. What does FSH stimulate in the male?
        b. What does FSH stimulate in the female?
     B. Luteinizing hormone (LH, ICSH)
        a. What does ICSH stimulate in the male?
        b. What does LH stimulate in the female?

   Define nontropic hormone.

2. List the nontropic (not tropic) hormones of the Anterior Pituitary. Give the functions of each.
   A. Human Growth Hormone (HGH, GH)
   B. Prolactin (PRL)
   C. Melanocyte Stimulating Hormone (MSH)

Posterior Pituitary Gland
1. How does it differ from the anterior pituitary?

2. What’s its connection (physically and functionally) with the hypothalamus?

3. Why is it “not really” an endocrine gland?

4. List the hormones associated with the posterior pituitary and give their functions. Where are they produced? Where are they stored?
   A. Antidiuretic hormone (ADH)
   B. Oxytocin (OT)

5. Describe diabetes insipidus (in detail).

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Thyroid Gland
The thyroid secretes two separate hormones and acts as two separate glands. This is very important to remember!!!! One aspect is concerned with regulating basal metabolic rate (BMR), cellular metabolism, and growth; while the other helps regulate calcium level in conjunction with the parathyroids. The hormones of the thyroid for BMR should be considered entirely separately in function while the thyroid and parathyroids should be considered together for calcium regulation. Remember this!!!!

Thyroid Gland Histology— (Thyroid and Parathyroid) Review from Lab
Identify these structures
- Follicles (what is in here?)
- Colloid (what is this?)
- Follicular cells (principle cells)
  a. *Thyroid hormones* (*T*$_3$—triodothyronine and *T*$_4$—thyroxine)
  b. Functions to regulate basal metabolic rate (BMR)
- Parafollicular cells
  a. *Calcitonin (thyrocalcitonin)*—↓Ca$^{2+}$
  b. Functions in calcium regulation
  c. Compare to function of Thyroid hormones T3 and T4

Parathyroid Gland Histology—Thyroid and Parathyroid Histology from Lab
- Principal cells (chief cells)
  o *parathyroid hormone (PTH)*—↑Ca$^{2+}$, ↑Mg$^{2+}$, ↓HPO$_4^{2-}$
  o compare to thyroid calcitonin (CT)

*Functions of the Parathyroid Gland:*
1. Review calcium-regulating functions (negative feedback mechanism) of the thyroid and parathyroid glands.
2. What are the targets of calcitonin and what effects does it have on these targets?
3. List the targets of PTH (osteoclasts, kidneys, intestine) and tell what effect PTH has on each (calcium, phosphates, calcitriol).

*For Review/Comparison:*
1. What are the targets of thyroxin?
2. ________, a tropic hormone from the ____________ regulates thyroxin production.
3. Is calcium regulation under the control of a tropic hormone? How does it compare to this?
4. What do HGH, thyroid hormones, and insulin have in common?
5. A lack of thyroid hormones (*T*$_3$ & *T*$_4$) during development or childhood causes?
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Adrenal Gland
The adrenal gland has two basic layers—the adrenal cortex and the adrenal medulla. The adrenal medulla produces the sympathomimetic hormones, epinephrine and norepinephrine (NE). The adrenal cortex is divided into 3 concentric layers and produces several hormones.

Adrenal Histology—Review from Lab
- Capsule
- Adrenal medulla—NE, epinephrine
- Adrenal cortex
  - Zona glomerulosa—mineralcorticoids (aldosterone)
  - Zona fasciculata—glucocorticoids (cortisol)
  - Zona reticularis—gonadacorticoids (androgens, estrogens)

Draw a diagram of the Adrenal Gland and its structures here. Include specific layers! Indicate what hormone is produced in each layer.

Functions of the Adrenal Gland
1. Review AGAIN: Renin-Angiotensin-Aldosterone pathway (Text Figure 18.16).

2. Describe each of these functions of glucocorticoids (see text)
   a. Protein catabolism
   b. Gluconeogenesis
   c. Lipolysis
   d. Resistance to stress
   e. Anti-inflammatory effects
   f. Depresses immune response

3. Overall, what effect do glucocorticoids have on glucose levels and other products that make ATP synthesis possible?
4. Describe this regulatory pathway: Hypothalamus (CRH)—Anterior Pituitary (ACTH)—adrenal cortex (glucocorticoids). What stimulates CRH in the first place?

5. Connect the functions of the Adrenal Gland with Stress and the General Adaptation Syndrome (Fight-or-Flight, etc). See Fig. 18.20. Outline The 3 Phases of the General Adaptation Syndrome (GAS) below (in detail—you may need another page for this). Study this very carefully!!!!!

6. Androgens are secreted in both males and females from the adrenal cortex. In males, the amount is so low it is overshadowed by androgens (testosterone) from the testes.

7. Androgens play an important role in females. Describe their functions:
   a. Libido (sex drive)
   b. Converted into estrogens—important in menopause
   c. Controlled by ACTH of the ________________________.
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Pancreas
As you already know, the pancreas is both an endocrine and an exocrine gland. It produces hormones, which it secretes through ductless glands, and also digestive enzymes, which travel through tubules to the Duct of Wirsung and on to the duodenum. (review digestion if you don’t remember this).

Pancreas Histology— Review histology from digestion lab.
- Acini (acinar cells)— exocrine secretions
- Islets of Langerhans (Islet Cells)— endocrine secretions
  - Alpha cells— glucagon → glucose level in blood
  - Beta cells— insulin → glucose level in blood

Review Functions of the Pancreas
1. Describe the exocrine and endocrine functions of the pancreas.
2. Describe glucose regulation via glucagon and insulin.
3. Review “G-words”. Relate this to the Sympathetic Fight-or-Flight Response and/or the Parasympathetic Rest-Repose response. Also, relate the Fight-or-Flight response and your G-words to Stress and the General Adaptation Syndrome (see above with adrenal gland)
4. Review and relate 2 and 3 to the absorptive (fed) state vs. the post absorptive (non-fed) state (previous notes and text)
5. Review digestion histology lab for more detail as needed.

Reproductive Histology—Male

Testis— review histology from reproductive lab
- Interstitial cells of Leydig— testosterone
- Sertoli cells— inhibin
  - what else do they do?

Review Questions from Reproductive Lab/lecture.
1. What is the target of testosterone?
2. Where are related gonadatropic hormones produced and what is their target?
3. Which gonadatropic hormone regulates testosterone levels?
4. Which gonadatropic hormone regulates spermatogenesis.
5. Review lecture notes and reproductive lab/lecture for more detail.

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Reproductive Histology—Female

Ovary—review histology from reproductive lab/lecture
- Growing follicles—estrogens (and some progesterone)
- Corpus luteum—progesterone and estrogen and inhibin

Review Questions from Reproductive Lab/lecture.

1. The hypothalamus releases the gonadotropic hormone, GnRH, which stimulates FSH and LH produced in the __________ ____________.

2. The targets of FSH and LH are the ___________________________ in the ovary.

3. Where are estrogens and progesterone produced?

4. Relate FSH, LH, estrogens, and progesterone (and others) to the ovarian cycle and the menstrual cycle. See Text Fig. 28.24 and lecture.

5. Review lecture notes and reproductive lab for more detail.

6. Hormones of pregnancy, delivery, and lactation will be covered with reproductive system and/or with other glands.