INTRODUCTION:

The endocrine system is a diffuse system, scattered throughout the body. It is composed of numerous organs that serve strictly an endocrine function (i.e., secretion of hormones) and many endocrine tissues or cells that are part of larger organs. All endocrine organs and tissues are glands that are ductless. They secrete these chemical messengers, called hormones, into the bloodstream to travel to distant target tissues where each hormone exerts its actions.

Hormones are chemical signals the body uses to direct biological actions. Each hormone can only stimulate a response in cells that have receptors for that hormone. The location of the receptor can be on the external surface of the plasma membrane or inside the cell, and this is dictated by the chemical nature of the hormone. Without receptors hormones have no ability to cause cells to change their function, and the body tightly regulates the number of receptors at a target tissue. This can either increase or decrease to meet changing needs of the body.

Many homeostatic mechanisms are tightly regulated by hormone actions. Some examples include the regulation of blood glucose levels by insulin and glucagon, the regulation of water balance by antidiuretic hormone, and the regulation of sodium and potassium concentrations in the blood by aldosterone.

Other hormones play critical roles in other physiological processes of the human body. For example, estrogen and progesterone promote female sexual characteristics during puberty and regulate ovarian and uterine function in women, testosterone promotes male sexual characteristics during puberty and regulates sperm production in men, and oxytocin stimulates uterine contractions during childbirth and the expression of milk during breastfeeding.

As you would expect, therefore, the production of hormones in the different endocrine organs and tissues is itself a highly regulated process. We will address that in this lab as well.

This lab has two major components: an anatomical overview and a physiology exercise. Remember that you will probably need to spend time in open lab to move from familiarity with the information to understanding the where and how our endocrine system work.
LEARNING OBJECTIVES:
Upon completion of this exercise students will be able to:
1. Identify major endocrine glands on models and figures of the human body.
2. Describe the structures and functions of major endocrine organs
3. Identify the major hormones secreted by endocrine organs, the functions of these hormones on their target tissues, and the stimuli or trophic hormones which stimulate their secretions.
5. Define pre-diabetes and diabetes.
6. Predict pre-prandial and postprandial values for individuals with diabetic, pre-diabetic and normal blood glucose concentrations.

A. ENDOCRINE GLAND ANATOMY:

Exercise 1: Organ overview

Part 1: Working in a group of three to four students, identify the following major endocrine organs on figure 17.1 and on a torso model.

1. Pituitary gland
2. Pineal gland
3. Pancreas
4. Adrenal gland
5. Thyroid gland
6. Parathyroid gland
7. Ovary
8. Testes

Part 2: As our knowledge of the endocrine system expands, more and more organs appear to have some endocrine gland function. Some of the glands on the torso model would be considered minor glands. Identify these minor endocrine glands on the torso model and figure 17.1:

1. Kidney – erythropoietin
2. Heart -- atrial natriuretic hormone
3. Liver – angiotensinogen (precursor to Angiotensin II)
4. Thymus – thymosins, thymopoietin, thymulin

Once organ identification is complete, label each of these on the diagrams on the Laboratory Worksheet at the end of this exercise. As you study each endocrine organ or tissue, list the function of the hormones secreted by each endocrine gland – tables 17.4 and 17.5 in your Saladin text will help you do this.

In addition to identifying the function, on that chart you will also list the stimuli or tropic hormones which promote the release of each hormone. That will require you to access and read additional information from other sources (including, but not limited to, your textbook)
**Part 3:** Let’s begin with a quick review of the **hypothalamus** because this part of the brain plays a major role in the regulation of the entire endocrine system. Using figure 14.2 as a reference, examine a model of the brain and identify the hypothalamus on its inferior surface. The hypothalamus forms the floor and walls of the third ventricle of the brain (figures 14.2, 14.12, and 17.4).

The **hypothalamus** is connected to the **pituitary gland**, also called the **hypophysis**, by both neurons and blood vessels which form the **infundibulum**. By regulating the function of the pituitary gland, the hypothalamus is a major control center for many of the hormones in the body – see table 17.3 in your Saladin text. The hypothalamus also plays an important role in the regulation of satiety, metabolism, sex drive and body temperature through its communications with the autonomic nervous system.

**SPECIFIC ENDOCRINE GLANDS:**

**Exercise 2: Pituitary Gland**

**Part 1:** Some of the brain models have a **pituitary gland** attached to the inferior surface, and you should also be able to identify it on figures 14.2, 14.12, 17.1, and 17.4. It is suspended from the floor of the hypothalamus by a stalk called the **infundibulum** and is located in the depression of the sphenoid bone called the **sella turcica**. Find this depression on a skull. The pituitary gland is approximately the size and shape of a kidney bean and is composed of two structures: the **anterior pituitary** or **adenohypophysis**, and the **posterior pituitary** or **neurohypophysis**. These two structures have independent origins developmentally, and have distinct physiological functions.

Examine figure 17.4a and note that neurons extend from two nuclei of the hypothalamus, the paraventricular nucleus and supraoptic nucleus, through the **hypothalamic-hypophyseal tract** to terminate in the **posterior pituitary**. This indicates that the secretions from the posterior pituitary are neurosecretions and are sometimes called **neurohormones**. The paraventricular nucleus is responsible for the synthesis of **oxytocin** which promotes uterine contraction or milk ejection, while the supraoptic nucleus produces **antiuretic hormone** which prevents the loss of excess water in the urine. Like all hormones, these diffuse into nearby capillaries to be distributed throughout the body.

Tropic hormones are also released by the hypothalamus which are carried to the **anterior pituitary** by small blood vessels, or venules, where they control the release of six different hormones: **growth hormone**, **prolactin**, **thyroid stimulating hormone**, **adrenocorticotropic hormone**, **luteinizing hormone**, and **follicle stimulating hormone**. Look at figure 17.4b and note the extensive capillary networks associated with the hypothalamus and anterior pituitary. If we follow the superior hypophyseal artery, it branches into a primary capillary bed right at the base of the hypothalamus. This capillary bed is drained by portal venules that terminate in a second capillary bed surrounding cells of the anterior pituitary. This arrangement of vessels connecting two capillary beds in a series is called a portal system, and this specific one is called the **hypothalamo-hypophyseal portal system**.
Part 2: Part of learning the anatomy of any system involves examining its tissues and organs at a microscopic level. This examination reveals specific cellular structures and tissue organization you will be required to know. Remove slide 34 from the slide box and place on a piece of white paper. Notice with your naked eye the pituitary gland slide has two distinct parts. The darker stained region is the anterior pituitary, and the lighter stained region is the posterior pituitary.

Place the slide on the stage of the microscope and focus with the lowest power (4x) objective. (Remember that you always want to start on low power.) Scan the slide and find the junction between the anterior pituitary and the posterior pituitary, then examine the tissues with the higher powered objective lenses of your microscope.

Notice that the cells of the anterior pituitary are relatively cuboidal in shape and have relatively large nuclei. Remember that the anterior pituitary is glandular in nature. Now examine the posterior pituitary on the opposite side of the junction. This has an almost fibrous appearance with numerous small dark nuclei interspersed. Recall that the posterior pituitary is an extension of neurons which begin in the hypothalamus – brain tissue. It is composed of bundles of axons (the more fibrous appearance -- tracts) intermixed with glial cells (the darker, small nuclei) (figure 17.5, p. 636).

Part 3: In the space provided on the Laboratory Worksheet, draw what you see in your field of view for the anterior pituitary and posterior pituitary. Then compare your drawing to that of your lab partners and also figure 17.5 in your Saladin text. This is not about how well you draw, rather it is the actual act of drawing that helps you remember the structures that you are observing at a cellular/tissue level.

On the endocrine chart on the Laboratory Worksheet at the end of this exercise, fill in the functions of the six hormones of the anterior pituitary and the two hormones of the posterior pituitary. List their tropic hormones or the physiological events which stimulate their secretion.

Exercise 3: Thyroid Gland

Part 1: The thyroid gland is one of the easiest glands to palpate. Locate your larynx, then run your fingers down your trachea towards your sternum. You should feel the cartilaginous supports of your trachea, and you should also feel the soft thyroid gland which spans this structure a couple of centimeters inferior to the larynx. While our palpation is kind of crude in nature, practiced physicians, nurses, and other healthcare professionals learn to detect gland texture as well as size with just their fingers.

The thyroid gland itself is butterfly shaped with two lobes (left and right) on either side of the trachea and a bridge-like structure called the isthmus connecting them anteriorly (figure 17.9a).

Locate the thyroid gland on the torso models.
Part 2: Remove slide #4 from the slide box, place it on the stage of the microscope, focus on low power, then advance to high power. The most notable feature on this slide is the numerous functional units interspersed throughout the gland called thyroid follicles (figure 17.9b). The walls of each follicle are composed of simple cuboidal epithelial tissue. The lumen of the follicle is filled with a protein-rich colloid which is a precursor of the thyroid hormones thyroxine (tetraiodothyronine or T4) and triiodothyronine (T3).

You may also observe clusters of cells located between the follicles called parafollicular cells. These cells, also called clear cells or C-cells, are hard to distinguish on a normal slide, but you need to know that these cells exist and are the source of the hormone calcitonin which helps prevent hypercalcemia. Label the parafollicular cells in your diagram as well. Once complete, compare your diagram to the website illustration and to the diagrams of your lab partners.

Part 3: In the space provided on your Laboratory Worksheet draw what you see in the microscopic field of view for the thyroid gland. Label the thyroid follicle with the colloid inside of it and the follicular cells.

On the endocrine chart on the Laboratory Worksheet at the end of this exercise, fill in the functions of the hormones produced by the thyroid gland and list their tropic hormones or the physiological events which stimulate their secretion. Pay particular attention to the role of thyroid stimulating hormone from the anterior pituitary gland.

Exercise 4: Pancreas

Part 1: The pancreas is an elongate glandular structure located below and behind the stomach (figure 17.12a). The bulk of the gland is exocrine tissue which releases digestive enzymes into the small intestine through the pancreatic duct. Only a small portion of this gland is devoted to endocrine actions.

Locate the pancreas on the torso models.

Part 2: Remove slide #20 from the slide box, focus on low power, then step up to high power. Identify the darker exocrine cells. Scan the slide until you see clusters of lighter stained endocrine cells forming the pancreatic islets (figure 17.12b,c).

The exocrine tissue is composed of tightly packed serous acini that appear like rather puffy cell collections. The histological stain used is specific for the rough endoplasmic reticulum (RER) which makes enzymes and proteins in the cells. Because these serous acini secrete digestive enzymes, they have more RER and are therefore stained darker.

The islet cells are paler in color. A fine connective tissue capsule surrounds the entire islet, but you will not be able to see this under the light microscope. Instead, you will only see that the endocrine cells are packed together to form the islet which is lighter than the surrounding exocrine tissue. There are several cell types within each islet including alpha cells which secrete glucagon to increase blood glucose and prevent hypoglycemia, beta cells which secrete insulin to decreases blood glucose and prevent hyperglycemia, and delta cells which secrete...
somatostatin to help regulate digestion as well as secretion of insulin or glucagon. You will not be able to identify these different cell types with the staining used on this slide.

**Part 3:** In the space provided on your Laboratory Worksheet, draw the histology of the pancreas as seen in the microscope field of view. Label the **serous acini** of the exocrine pancreas and the **pancreatic islets**. Then compare your diagram to that of your classmates and figure 17.12c in your Saladin text.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of and in the hormones of the pancreatic islets. List their tropic hormones or the physiological events which stimulate their secretion.

**Exercise 5: Adrenal Gland**

**Part 1:** The **adrenal glands** are small, almost triangular shaped glands superior to the kidneys (figure 17.11a). The glands are about the size of a hazel nut. Like the pituitary, the adrenal gland develops from two distinct glands in the embryo, both with endocrine functions.

Identify the adrenal gland on the torso model.

**Part 2:** Remove slide # 36 from the slide box and focus on low power. The entire gland is typically surrounded by a layer of adipose tissue, deep to which is a connective tissue capsule surrounding the gland proper. Move to medium or high magnification and focus on the outer part or **cortex** of the adrenal gland. This forms about 80-90% of the entire organ and completely surrounds the inner **medulla** which forms about 10-20% of the organ. The cortex surrounds the deep medullary tissue and is divided into three layers. From superficial to deep these are the **zona glomerulosa**, **zona fasciculata** and **zona reticularis** (figure 17.11b). You are not responsible for identifying the specific cortical layers histologically, but you should know the three classes of **corticosteroid hormones**: mineralocorticoids, glucocorticoids, and **androgens** such as dehydroepiandrosterone.

The **adrenal medulla** is actually a large ganglion of the sympathetic nervous system which functions as an endocrine organ. Chromaffin cells make up this ganglion and are responsible for secreting the **catecholamine** hormones **epinephrine**, **norepinephrine** and **dopamine**. Note the highly vascular nature of the adrenal medulla and ponder how these blood vessels are needed to carry catecholamines to the body following secretion at these modified sympathetic nerve endings.

**Part 3:** In the space provided on your Laboratory Worksheet, draw the histology of the adrenal gland as seen in the microscope field of view. Label the adrenal medulla and the adrenal cortex. Then compare your diagram to that of your classmates and figure 17.11b in your Saladin text.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of the hormones of the adrenal cortex and the adrenal medulla. List their tropic hormones or the physiological events which stimulate their secretion. Pay particular attention to the role of adrenocorticotropic hormone from the anterior pituitary gland.
Exercise 6: Gonads

Part 1: The ovaries are not only reproductive organs responsible for producing egg cells called oocytes, but they are also endocrine organs which secrete estrogens and progesterone (figures 28.1, 28.2, 28.13). The ovaries are small, almond-shaped organs.

Identify the ovaries in the figures in your text and on the torso models. Note that not all of the torso models in our lab show the ovaries or other organs of the reproductive system, so you will need to select ones which do.

Each ovary has a cortex and medulla, like many of the other organs examined (figure 28.2), surrounded by a fibrous capsule. Each month, one (or rarely two) follicles develop within the cortex of an ovary, consisting of a layer of epithelial cells surrounding an oocyte, and it is this structure which begins to secrete steroid hormones. The follicles can be at various stages of development, although most are primordial follicles which have not yet started to develop (this differs from figure 28.2 in your book which illustrates the various stages of development through which a follicle may progress). As a follicle matures before ovulation (figure 17.13a), the epithelial cells surrounding the oocyte form granulosa cells which secrete a group of closely related hormones called estrogens. After ovulation, those cells form a structure called the corpus luteum which secretes the hormone progesterone.

Part 2: Remove slide #40 from the slide box and focus using low power. At this point you should be able to see the entire ovary section. Most of the slides in our lab are an ovary from a cat or other animal which gives birth to litters of multiple offspring, so they show many different follicles developing at the same time. Notice the cortex and the medulla, although there is no sharp boundary between them. Advance to 100X magnification, focus on the cortex, and identify a mature follicle with its large fluid-filled center and, if possible, an oocyte in the center. Advance further to 400x magnification and identify the granulosa cells.

Return to 100x magnification and find a cluster of darker cells within the cortex of the ovary. This cell cluster is a corpus luteum and is responsible for progesterone secretion that assists in maintaining pregnancy.

Part 3: In the space provided on your Laboratory Worksheet, draw the histology of the ovary in the microscope field of view. Label the granulosa cells and the oocyte of a developing follicle, and the corpus luteum. Compare your diagram to that of your classmates and figure 17.13 in your Saladin text.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of the hormones produced by the granulosa cells and by the corpus luteum of the ovary. List their tropic hormones or the physiological events which stimulate their secretion. Pay particular attention to the roles of follicle stimulating hormone and luteinizing hormone from the anterior pituitary gland.
Part 4: The testicles or testes, like the ovaries, have two functions: formation of sperm and production of hormones. Testes are paired organs housed in the scrotum. They are about the size of walnuts gross structure (figure 27.9).

Identify the testicles in the figures in your text and on the torso models. Note that not all of the torso models in our lab show the testicles or other organs of the reproductive system, so you will need to select ones which do.

Part 5: Remove slide #12 from the slide box and focus under low power. The most striking feature of this slide is numerous seminiferous tubules where sperm are produced. A layer of connective tissue called the tunica albuginea surrounds the entire testicle. Advance to high power and focus on a single seminiferous tubule (figure 17.13b). Sperm cells are produced in these tubules and you should be able to identify mature sperm in the lumen.

Forming the wall of the seminiferous tubule, look for cells with larger, lighter-staining nuclei. These are the sustentacular cells (Sertoli cells) which surround the sperm as they develop. Sustentacular cells also secrete the hormone inhibin which exerts negative feedback on the pituitary gland to suppress production of Follicle Stimulating Hormone. In between the seminiferous tubules, identify interstitial cells (Leydig cells) that secrete the hormone testosterone.

Part 6: In the space provided on your Laboratory Worksheet, draw the histology of the testicle in the microscope field of view. Label a seminiferous tubule, sustentacular cells, and interstitial cells. Compare your diagram to that of your classmates and figure 17.13 in your Saladin text.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of the hormones produced by the sustentacular cells and by the interstitial cells of the testicle. List their tropic hormones or the physiological events which stimulate their secretion. Pay particular attention to the roles of follicle stimulating hormone and luteinizing hormone from the anterior pituitary gland.

Exercise 7: Other Endocrine Glands

Part 1: The pineal gland is an endocrine gland located near the posterior end of the corpus callosum of the brain. It is actually attached to the roof of the third ventricle and is considered part of the epithalamus (figure 14.2). This gland is associated with establishment of the 24-hour circadian rhythms our bodies experience with the light and dark cycles. Melatonin is a specific hormone of this gland and may be involved in sleep patterns and in the timing of puberty. Consider the function of this gland when wake up at 7am for your 8am class on Saturday morning or when you experience jet lag after returning from a vacation in Europe.

Locate the pineal gland on a brain model.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of melatonin. List its tropic hormones or the physiological events which stimulate its secretion.
Part 2: The thymus is an organ of the immune system which also has endocrine functions. It undergoes considerable changes with age, reaching its peak size at puberty and then undergoing involution. It lies in the anterior mediastinum and can extend up to the thyroid gland and down towards the 4th and 5th costal cartilage (figure 17.8). This gland is not obvious on the torso models, so you only need to know it from the above diagrams.

The thymus is the site for T cell (lymphocytes) development and maturation. Hormones of the thymus are thymosin, thymopoietin, thymulin and interleukins all involved in the development of a mature immune system.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of the hormones produced in the thymus. List its tropic hormones or the physiological events which stimulate their secretion.

Part 3: The kidney, the heart, and the liver are examples of organs in other systems which have a small endocrine function.

Identify these on the torso model.

Go to the endocrine chart on the Laboratory Worksheet and list the functions of the hormones produced by cells of the kidney, the heart, and the liver. List their tropic hormones or the physiological events which stimulate their secretion.

B. ENDOCRINE PHYSIOLOGY
(This exercise should take approximately half of the class period.)

Introduction:
Diabetes Diagnosis:
Insulin, released by the beta cells of your pancreatic islets, promotes glucose uptake from the blood into the cells. Diabetes mellitus is a metabolic disorder related to defects in insulin secretion and/or in defects of target cell responsiveness to insulin. Without insulin, the blood glucose concentration would greatly increase. There are three major forms of the disease: Type 1, Type 2 and gestational diabetes.

In 2012, 7.3% of Minnesotans were diagnosed with diabetes (type 1 or 2). However, many individuals are unaware that they have diabetes so the actual number of residents in the state might be much higher. Most people with diabetics are 65 years old or older, but the number of young people being diagnosed is on the rise and appears to be linked with obesity and inactivity. Overall, diabetes is associated with older adults, overweight and obese adults, some ethnic groups, people with a family history of type 2 diabetes, and individuals who are sedentary.
It is estimated that over 86 million people in the United States are pre-diabetic, where the individual’s blood glucose concentration are higher than normal (fasting blood glucose of 70-100mg/dL), but not high enough for a diabetic diagnosis. In Minnesota this value may be as high as 35% of the adult population.

The concentration of glucose in the blood is used to give an indication of blood glucose control at a specific time. Long-term control of blood glucose, however, is evaluated using a test called glycated hemoglobin (HbA1c). This assay for glycated hemoglobin reflects blood glucose control over the last three months because poor glycemic control (periods of hyperglycemia) will cause glucose to become inappropriately attached to hemoglobin molecules.

<table>
<thead>
<tr>
<th>Blood Glucose Concentrations for Diagnosis of Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-prandial Blood Glucose Concentrations</strong></td>
</tr>
<tr>
<td>Normal Values: &lt; 100 mg/dL</td>
</tr>
<tr>
<td>Pre-diabetes: 100 mg/dL – 126 mg/dL</td>
</tr>
<tr>
<td>Diabetes: &gt; 126 mg/dL</td>
</tr>
<tr>
<td>Hypoglycemia: &lt; 70 mg/dL</td>
</tr>
<tr>
<td><strong>Postprandial Blood Glucose Concentrations</strong></td>
</tr>
<tr>
<td>&lt; 140 mg/dL</td>
</tr>
<tr>
<td>140 mg/dL – 200 mg/dL</td>
</tr>
<tr>
<td>&gt; 200 mg/dL</td>
</tr>
<tr>
<td>&lt; 70 mg/dL</td>
</tr>
</tbody>
</table>

“Pre-prandial” means before a meal and these are often called “fasting” blood glucose values. “Post-prandial” means after a meal has been eaten and nutrients have been absorbed.

**Exercise 8: Measuring and Interpreting Blood Glucose Concentrations**

**Part 1:** Your lab instructor will demonstrate the use of an electronic meter which is commonly used to measure the concentration of glucose in the blood, and will provide you with results (blood glucose concentrations) to be used in evaluating the normal or diabetic status of three hypothetical patients described below. Although you will not be measuring your own blood glucose values, you should understand the steps demonstrated by your instructor so you should watch closely:

**Note:** It is common practice in any lab to assume that every blood sample you deal with is tainted with something harmful, and your lab instructor will follow the same safety procedures for this demonstration. This includes wearing disposable gloves, properly disposing of contaminated objects, and cleaning any surfaces that may have become contaminated. You will learn and follow these in a future lab when you will be working with your own blood.

1. Place an unused test strip into the glucose meter. Allow the meter to power up and recognize that a test strip is in place. You should see a blood drop symbol in the meter’s display indicating that the meter is waiting for a sample.

2. Once the meter has powered up and is signifying it is ready, a drop of blood is placed on the test strip while it remains in the meter. The concentration of glucose in the blood sample will be displayed on the meter as milligrams of glucose per deciliter of blood (mg/dL). One milligram is one thousandth (1/1000 or 0.001) of a gram, and a deciliter is one-tenth (1/10 or 0.1) of a liter.
**Part 2:** In this exercise you will be following the case histories for three patients, including assessing their blood sugar levels is samples collected 30 minutes after a meal. Your lab instructor will provide you with those blood glucose concentrations for each of these patients.

**Patient 1** is a 21-year old woman who has experienced weight loss and is generally concerned about her health. She has had no previous health problems. Her family does have a history of diabetes although she is not sure of the type of the disorder. She is a typical college senior.

The 30-minute postprandial concentration of blood glucose for this patient will be provided by your instructor. Record this in the proper place on your Laboratory Worksheet and interpret her blood glucose status. Does this indicate that she is healthy, or does it indicate that she has either hypoglycemia or hyperglycemia?

**Patient 2** is a 50-year old man complaining of a lack of energy. He is overweight and does not exercise; his diet consists mostly of processed foods. His family has a history of Type 2 diabetes.

The 30-minute postprandial concentration of blood glucose for this patient will be provided by your instructor. Record this in the proper place on your Laboratory Worksheet and interpret his blood glucose status. Does this indicate that he is healthy, or does it indicate that he has either hypoglycemia or hyperglycemia?

**Patient 3** is a 12-year old girl of average size. She complains of frequent urinations and excessive thirst. She lacks energy and has experienced unexplained weight loss. Her parents brought her to the doctor because she is complaining of severe stomach pain.

The 30-minute postprandial concentration of blood glucose for this patient will be provided by your instructor. Record this in the proper place on your Laboratory Worksheet and interpret her blood glucose status. Does this indicate that she is healthy, or does it indicate that she has either hypoglycemia or hyperglycemia?

Based on the above descriptions, speculate on your Laboratory Worksheet what you might have expected the pre-prandial blood glucose reading to have been for each patient. As a group, answer the “thought questions” at the end of your Laboratory Worksheet.
Worksheet for Endocrine Anatomy & Physiology Laboratory

This worksheet is designed to help you progress through the lab exercise. Follow the directions and complete the information.

**Exercise 1**

Use a highlighter and identify the pituitary and the hypothalamus.

Fill in the name of the endocrine organs as indicated by the arrows on the torso diagram below: Some of the organs are deep to the other structures. The ones tinted in blue are deep to the large and small intestine and liver. Also the male reproductive system is not shown.
Feel free to add any additional organs that you see fit – this is suppose to be a work in progress.
**Exercises 2-7**

**Endocrine Hormone Chart:** Much of this chart can be completed outside of class but the content of this table should be understood for the laboratory exam.

<table>
<thead>
<tr>
<th>Endocrine Organ</th>
<th>Hormone</th>
<th>Function of Hormone</th>
<th>Tropic Hormone causing it to be released or the stimulus for its release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineal Gland</td>
<td>Melatonin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior Pituitary</td>
<td>Oxytocin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior Pituitary</td>
<td>Antidiuretic Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Growth Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Prolactin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Luteinizing Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Follicle Stimulating Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Thyroid Stimulating Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Adrenocorticotropic Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>Erythropoietin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td>Atrial Natriuretic Protein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td>Angiotensin II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thymus</td>
<td>Thymosin, Thymopoietin, Thymulin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tissue</td>
<td>Hormone/Peptide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thyroid (follicular cells)</td>
<td>Thyroxin, Triiodothyronine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thyroid (Clear cells)</td>
<td>Calcitonin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parathyroid Gland</td>
<td>Parathyroid Hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>Insulin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>Glucagon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>Somatostatin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenal Cortex</td>
<td>Aldosterone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenal Cortex</td>
<td>Cortisol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenal Cortex</td>
<td>Dehyroepiandrosterone and other Androgens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenal Medulla</td>
<td>Epinephrine and other Catecholamines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovary (granulosa cells)</td>
<td>Estrogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovary (corpus luteum)</td>
<td>Progesterone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testes (sustentacular cells)</td>
<td>Inhibin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testes (interstitial cells)</td>
<td>Testosterone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For the following questions, work with your lab partner and adjacent study groups. Follow along as you work through the laboratory exercises.

1. What role does the hypothalamus play in controlling the secretions of the pituitary gland?

2. Define portal system. Then speculate on the significance of such structures.

Draw the histology of the pituitary gland as observed under the microscope. Off to one side, explain in words how you would distinguish the anterior pituitary from the posterior pituitary. Compare your answer with that of your lab partner.

Draw the histology of the thyroid gland. Label the thyroid follicle with the colloid inside and the follicular cells. Identify where the parafollicular cells (i.e., C cells) should be located.

Draw the histology of the pancreas as seen in the microscope field of view. Label the serous acini and the pancreatic islets. Compare your diagram to that of your lab partner, then write how you will distinguish the cell types present.
Draw the histology of the **adrenal gland** slide. Label the adrenal cortex and the adrenal medulla. What is the difference between them? Compare your diagram with your study partner and explain to each other the function of the structures and how you will distinguish these structures on a lab practical.

7. Draw the histology of the **ovary** slide. Then compare your diagram with your study partner and explain to each other the function of the structures and how you will distinguish these structures on a lab practical.

8. Draw the histology of the **testes** slide. Label the seminiferous tubules, germ cells and interstitial cells. Compare diagrams and discuss with your study partner how you will distinguish these structures on a lab practical.
**Endocrine Physiology Worksheet:**

State your hypotheses about the three patients and their blood sugar values based on the clinical information presented in the handout:

<table>
<thead>
<tr>
<th>Patient’s Glucose Concentrations (See Instructor Demonstration Measurements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postprandial blood glucose (mg/dL)</td>
</tr>
<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Patient 1</td>
</tr>
<tr>
<td>Patient 2</td>
</tr>
<tr>
<td>Patient 3</td>
</tr>
</tbody>
</table>

Compare your values to those of the reference table given in the introduction and write your conclusions in the space provided in the table above.

Based on the case history and her 30-minute post-prandial blood glucose concentration, what do you think Patient #1’s pre-prandial blood glucose concentration might have been? Why?

Based on the case history and his 30-minute post-prandial blood glucose concentration, what do you think Patient #2’s pre-prandial blood glucose concentration might have been? Why?

Based on the case history and her 30-minute post-prandial blood glucose concentration, what do you think Patient #1’s pre-prandial blood glucose concentration might have been? Why?
Address these **thought questions** on your worksheet as a group. Then compare your answers with those of another table.

a. Are the postprandial blood glucose levels different for the three patients? Why?

b. What are the risk factors for type 1 and type 2 diabetes? Why do doctors recommend exercise for their patients with Type 2 diabetes?

c. A hypothetical patient is a responsible diabetic who exercises regularly, eats healthy, and takes her medications properly. The patient checks her blood glucose concentration in the morning after she awakens and it is typically high. Why might her blood glucose concentration be higher in the morning then at other times of the day?

d. A patient has been recently diagnosed with diabetes. He uses insulin injections in order to control his diabetes. He has experienced a slight weight gain since starting treatment. What are some possible reasons for such a weight gain?

e. A patient with diabetes becomes shaky and light-headed multiple times a week. What condition are these symptoms characteristic of? What are some possible causes of the condition?