**Study guide for Unit 5 Exam**

**Digestive System**

1. Explain the endocrine and exocrine functions of the stomach and duodenum. Name the types of cells and their secretions

2. Explain how carbohydrates, proteins and lipids are digested and absorbed to make it to the circulation.

3. Describe the physiology of the lipid delivery system. Explain the formation and functions of the chylomicrons, VLDLs, IDLs, LDLs and HDLs.

4. Be sure you can explain and fully understand the case study shared in class about the gastrinoma. Be sure you can explain and fully understand the case study in lab for the thyroid issues.

**Endocrine System**

1. Discuss the three chemical classes of hormones and give examples.

2. Compare the location of hormone receptors and the cellular mechanisms of action for hydrophobic and hydrophilic hormones

3. Compare and contrast the anterior and posterior pituitary glands.

3. Discuss the major functions of each hormone from the posterior and anterior pituitary glands.

4. What is the chemical nature of growth hormone? How is growth hormone secretion regulated?

5. What are the direct and indirect actions of growth hormone on its target tissues?

6. What is the relationship between GH and insulin-like growth factor?

7. Describe the effects of hyper and hypo secretion of growth hormone.

8. Describe the histology of the thyroid gland.

9. Explain the steps in the synthesis of thyroid hormone including how T3 and T4 are produced.

10. What is the target tissue for thyroid hormones and which hormone is the active form in the tissues?

11. What are the actions of thyroid hormones on the target tissues?

12. What are the effects of hypo and hyper secretion of thyroid hormone.

13. Describe how the endocrine system regulates calcium levels in the blood

14. Describe the histology of the adrenal gland.

15. Describe the physiology of cortisol. What regulates its secretion? What are the target tissues? What are its actions?

16. Know the consequences of hyper and hypo secretion of cortisol.

17. Describe the structure of the endocrine pancreas.

18. Explain the physiology of insulin. What controls its secretion? What is the nature of the insulin receptor? What are its target tissues? What is its action in each of its target tissues?

19. How is glucagon secretion regulated, what is its target tissue and what are its actions?

20. Compare and contrast type 1 and type 2 diabetes mellitus.

21. Explain sex determination during embryonic development.

22. Describe the process of spermatogenesis.

23. What are the functions of the sertoli cells and leydig cells in the testes?

24. What are the functions of the epididymis, prostate gland and seminal vesicles?

25. Explain the role of FSH, LH, Testosterone and inhibin in the physiology of male reproduction.

26. Know the phases of the menstrual cycle and the events taking place in the ovaries and the uterus during each phase, including the role of the various hormones.

27. Describe the process of follicle development in the ovaries.

28. What are the functions of the granulosa cells and the thecal cells in the follicles.

29. What is the corpus luteum and what is its function?

30. Know the actions of FSH, LH, estrogen, inhibin, and progesterone as they relate to female reproduction.

**Comprehensive Portion of the Exam**

**\*\*It is recommended that you go back over all of the essay questions presented to you previously this semester. Hopefully, you have written essays already for all of these and you can study that material to reacquaint yourself with that material. All of the essays are reproduced below for your convienience\*\***

**Unit 1**

1. Define homeostasis and give an example of how it might work in the body, include in your discussion the components of a reflex control pathway. Clearly explain negative and positive feedback loops and give some examples. In part two of this essay, describe the three types of protein mediated transport discussed in chapter 5 (diffusion through channels, carrier mediated diffusion, and active transport -‐‐ both primary and secondary). Address the concepts of specificity, rates, energy sources involved, competition, saturation, direction, etc.

2. Explain the process of osmosis. What is osmolarity and how does it differ from molarity? Explain how osmolarity and tonicity differ (i.e. How can a solution be isoosmotic and yet be hypotonic to a cell?).  In part two of this essay, Explain how the resting membrane potential (RMP) of the cell membrane is established. What properties/characteristics of the cell membrane account for its development? What conditions or factors affect its magnitude (size)? Include a brief discussion of the Nernst equation.

3. Discuss the action potential. List its characteristics. Describe the events that take place during a typical action potential including a description of the various phases (i.e. Rising phase, falling phase, after-‐‐hyperpolarization, relative refractory period, absolute refractory period). For each phase describe the actions of the channels involved and the ions currents. Compare and contrast a graded potential with an action potential. Give an explanation of Capacitance, Time Constant and Length Constant. Describe the structure of the chemical synapse and explain how signals pass from the presynaptic terminal to the postsynaptic terminal.

4. Compare and contrast the sympathetic division of the ANS, the parasympathetic division of the ANS and the somatic nervous system. Include such things as their points of CNS origin, number of neurons in the pathway, location of ganglia, neurotransmitters, types of receptors, and actions. Discuss the 4 pathways that can be taken by sympathetic neurons. Discuss cholinergic and adrenergic receptors. Explain the different subdivisions of each type. Give mechanisms of action for each type of receptor (i.e. what happens when the neurotransmitter binds to the receptor?

**Unit 2**

1. Describe the molecular characteristics of the contractile filaments found within the functional unit of the skeletal muscle cell; the sarcomere. Describe the mechanism by which an action potential in the sarcolemma results in release of Ca++ from the sarcoplasmic reticulum followed by a description of the molecular mechanisms of muscle contraction. Discuss the various sources of energy utilized for muscle contraction. Include the relative amount of each source available to the cell, the advantages and disadvantages of each type, under what conditions each might be used, etc.

2. Describe the two main types of smooth muscle. Describe the molecular mechanisms of muscle contraction in smooth muscle. Begin at the point of Ca++ entry and end at the point contraction ends. Compare and contrast smooth and skeletal muscle structurally, functionally, and regulation.

3. First describe and explain and then compare and contrast the muscle sensory receptors: muscle spindles and golgi tendon organs. Describe the stretch reflex and the withdrawal reflex. In part 2 of this essay, describe the chemoreception of smell and taste. Finally, describe how energy carried by sound waves turns into mechanical vibrations, fluid waves, chemical signals and finally action potentials for the things we hear.

4. Explain how the eye focuses light.  Be sure to mention the role of the ciliary body and suspensory ligaments surrounding the lens. Describe the two types of photoreceptors and explain how they convert light into electrical energy. Explain how center and surrounds cooperate in a visual field.

**Unit 3**

1. Describe the action potentials in cardiac ventricular muscle and in the SA node. During each phase of the action potentials describe the channels, ion currents and membrane potentials involved. In part 2 of this essay explain the ECG tracing and how each of the P, QRS and T waves are made.

2. Describe the events taking place in the left ventricle and aorta during the cardiac cycle. Include the various stages, blood volume changes, pressure changes, opening and closing of valves, and heart sounds. Finally, be sure you can explain the pressure volume curves for a single cardiac cycle.

3. Describe the mechanisms for the inotropic, lusitropic, and chronotropic actions of norepinephrine and acetylcholine on the heart. Explain the role of calcium in cardiac muscle contraction. Include the mechanism of its release into the cytosol and its return to the SR and extracellular fluids.

4. Explain the mechanism by which fluids normally move out of and into capillaries. Describe the various forces involved (i.e. hydrostatic and colloid osmotic pressure) and how these forces differ at the arterial and venous ends of the capillaries. Then, using inflammation as an example describe the mechanisms responsible for edema. In part 2 of this essay, describe the baroreceptor reflex. Include all of the components of the reflex and describe the chain of events that would occur if systemic blood pressure suddenly dropped. Explain how each of the following is involved in the regulation of blood flow: myogenic autoregulation, paracrines (include their role in active and reactive hyperemia), and sympathetic regulation.

5. Describe the composition of the blood. Include the components of the plasma. Describe the mechanism by which red blood cells are removed from the circulation. Especially explain how heme is broken down and what happens to the various components of the heme.  In part 2 of this essay describe the three mechanisms that contribute to hemostasis (vasoconstriction, platelet aggregation and coagulation). Special attention should be given to the role of the platelets and coagulation cascade. For the coagulation process describe the intrinsic, extrinsic and common pathways.

**Unit 4**

1. Explain how solutes and water are reabsorbed in the kidney tubules. Be sure to include the reabsorption of Na+, glucose, water, Cl-, Ca++, K+ etc. Include in your discussion how the various solutes are reabsorbed (i.e. sodium, glucose, amino acids) and the concept of renal threshold and saturation. Discuss the process of filtration. In your discussion, describe the filtration membrane in the renal corpuscle and the pressures involved in filtration. Discuss how blood flow may be regulated to the glomerulus. Describe what GFR is and then explain the principle of "clearance" and how it is used to estimate GFR.

2. Explain tubuloglomerular feedback. Explain the Renin/ Angiotensin/ Aldosterone system. Describe what happens at the cellular level with ADH and Aldosterone. In part 2 of this essay, explain how the loop of Henle is used to establish and maintain the renal medullary concentration gradient. Explain how this gradient and ADH can work together to excrete urine of different concentrations.

3. Explain all of the membranes, pressures and mechanisms that make negative pressure ventilation possible. Describe what a pneumothorax is and how it occurs. What is surfactant? How does a lack of surfactant impair ventilation (hint: water, surface tension and Laplace's Law)?  Explain how CO2 is transported in the blood. Describe O2 transport in the blood as well. Include a description of the oxygen hemoglobin-dissociation curve and factors that influence the affinity of hemoglobin for oxygen. How do these factors affect the oxygen / hemoglobin dissociation curve?

4. Explain Dalton's Law and Henry's Law and how these laws are used to explain pO2 and pCO2. Explain the alveolar gas equation and how the information it gives us might be used. Finally, explain ventilation and perfusion ratios and give examples of what might cause these ratios to change. In part 2 of this essay, explain total pulmonary and alveolar ventilation rates and describe why slow deep breaths are more beneficial than rapid shallow breathing. In part 3 of this essay, describe COPD and restrictive lung disease. Between these two diseases, mention what emphysema would be and then explain the mechanisms of "air trapping" in emphysema.