

15. Be able to label a small portion of a plasma membrane including the following:
 phospholipid bilayer structural proteins cholesterol
 List the function of each of these.
16. The plasma membrane is said to have selective permeability. Define the term selective permeability.
 Explain what selective permeability means functionally to a cell.
17. Name and describe the parts of a cell, giving the function of each part.
 cytoplasm nucleus ribosomes
 smooth endoplasmic reticulum rough endoplasmic reticulum golgi complex
 mitochondria lysosomes vesicles
 cilia flagella cytoskeleton
18. Describe how each of the following gets inside the cell:
 water lipids steroid hormones
 sodium glucose protein
19. Be able to describe the process of diffusion from high to low concentration and how it is affected by
 molecular weight and temperature.
20. Define osmosis. Explain the importance of the semipermeable membrane. Define each of the
 following types of solutions and describe what happens when RBCs are placed into them:
 isotonic hypertonic hypotonic
 Know the concentration of NaCl and glucose that are isotonic.
21. Know that active transport requires ATP, that it is specific for 1 compound and that it is used to
 concentrate a compound.
22. Describe the following ways for large particles to enter & leave a cell:
 endocytosis phagocytosis pinocytosis exocytosis

18. Describe the structure of a nail. Locate the growing point of nails.
19. Explain the role of skin body temperature control. (surface area, blood vessels and sweat)

Bones and Articulations

20. State what is meant by the term "skeletal system" and list 5 functions of the skeletal system.
21. Describe the structure of bone and its blood supply. There will be pictures to label on the lecture test. Be familiar with the following:
- | | | |
|---------------------|------------------|-------------------|
| osteoblasts | osteocytes | osteoclasts |
| organic matrix | inorganic salts | diaphysis |
| epiphysis | epiphyseal plate | periosteum |
| endosteum | medullary cavity | red/yellow marrow |
| articular cartilage | compact bone | spongy bone |
| Haversian Canal | Volkman's canals | lacuna |
| canaliculi | Haversian System | |
22. Describe how bone grows. Know that bone starts out as connective tissue and is slowly replaced by bone. Know how immature cells become osteoblasts then osteocytes. Describe the function of an osteoclast.
23. Describe the process of intramembranous ossification and endochondral ossification. Know how these 2 processes are different. Know where the primary and secondary ossification centers are.
24. Explain the process of growth (length and width) during childhood. Define epiphyseal plate and line.
25. Describe remodeling. Why does it happen? Describe the activities of osteoclasts.
26. Define osteoporosis. List 3 risk factors for osteoporosis. Explain the effect of immobility or exercise on bone. Be able to explain why postmenopausal women are at higher risk for osteoporosis and what women can do to reduce their risk.
27. Define what is meant by a joint or articulation. Give an example of each type of the following joints:
- | | | |
|-----------|------------------|-----------------|
| immovable | slightly movable | freely movable |
| gliding | hinge | pivot |
| condyloid | saddle | ball-and-socket |
28. Describe the structure of a freely movable joint. Describe 3 forces that keep our joints together. Be familiar with the following:
- | | | |
|---------------------|---------------|-------------------|
| articular cartilage | joint capsule | synovial membrane |
| synovial fluid | bursa | |
29. Be able to describe and identify demonstrations of the following movements:
- | | | |
|-----------------------|------------------------|-------------------------|
| flexion | extension | hyperextension |
| abduction | adduction | rotation |
| circumduction | dorsiflexion of foot | plantar flexion of foot |
| inversion of foot | eversion of foot | supination of forearm |
| pronation of forearm | protraction of jaw | retraction of jaw |
| elevation of shoulder | depression of shoulder | |
30. Describe what is meant by arthritis. Differentiate between rheumatoid arthritis and osteoarthritis, including the cause of the disease, which joints each disease attacks, and the age the person usually gets the disease.

Muscular and Nervous System

1. List the three main types of muscle tissue, give an example of each and state whether it is voluntary or involuntary.
2. Describe the structure of a skeletal muscle and its attachments and related structures. Include the terms:

tendon	fascia	epimysium	fascicle
perimysium	muscle fiber	endomysium	
3. Describe the structure of a skeletal muscle cell. Include the terms:

sarcolemma	myofibrils	thick filaments (myosin)
thin filaments (actin)	striations	

 Are muscle cells multinucleated or do they have 1 nucleus.
4. Describe how the thin (actin) and thick (myosin) filaments are arranged in the muscle cell.
5. Describe the process of muscle contractions. Define the role or the meaning of:

neuromuscular junction	acetylcholine	calcium
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 What must occur in order to sustain a contraction for 30 seconds?
6. Define a motor unit. What is the difference between a small motor unit and a large motor unit? Where would you expect to find each of these?
7. In a muscle, such as the biceps brachii, is there only 1 motor unit? Explain. What is motor unit summation? When would this occur?
8. Discuss the various energy sources for a muscle. Include the length of time the energy source lasts.

ATP	creatine phosphate	glucose (anaerobic & aerobic)
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9. Describe the differences between aerobic metabolism and anaerobic metabolism. Include how long it takes to make ATP and how much ATP the process can make. When do you make lactic acid? What is meant by fatigue?
10. State the three broad functions of the nervous system.
11. List the location of the central nervous system and the peripheral nervous system.
12. List three functions of neuroglia cells.
13. Describe the basic structure of a neuron, including the location and function of the following components:

cell body	dendrites	axons	synaptic knobs
myelin sheath	Schwann Cells	nodes of Ranvier	white matter
gray matter			
14. Can nerves regrow when damaged? Is your answer the same for axons, dendrites and cells bodies? Is your answer different for CNS and PNS nerves? List the parts of a neuron that must be present for nerve regeneration.
15. Describe the structure and function of the following structures:

sensory or afferent neurons	motor or efferent neurons
interneurons or association neurons	

ANS, Special Senses, Cardiovascular & Blood

1. Discuss the function of the two divisions of the autonomic nervous system. Why do we need 2 divisions?
2. Summarize the effects of the 2 divisions of the ANS on the following structures:
heart rate blood pressure bronchioles (lungs)
digestive organs blood flow distribution glucose release
3. Describe the interaction between the CNS and the ANS. How is the ANS linked to the limbic system?
4. List the differences between the cone cells and the rod cells of the retina of the eye. Where and what is the fovea centralis?
5. Discuss briefly how we focus. Why does the lens change shape as we look at something close or far away?
6. Describe the cause and symptoms of the following conditions:
myopia (near-sighted) hyperopia (far-sighted) astigmatism
7. Where is the blind spot of the eye? Why do we have a blind spot? Does the blind spot cause us any problems?
8. Locate the outer, middle and inner ear in relation to the bones of the skull.
9. Describe the function of the following ear parts:
tympanic membrane middle ear bones inner ear
organ of corti hair cells
10. Trace the transmission of sound waves from the air to the stimulation of hair cells of the organ of Corti. Show how pitch of the sound waves is distinguished.
11. Describe the function of the semi-circular canals, utricle and saccule. List examples of rotational and static balance.
12. Describe how movement (acceleration and rotation) is detected by these receptors and how this is converted into nerve impulses. What part of the brain receives these nerve impulses?
13. List the components of the cardiovascular system.
14. Know the names of the membranes that cover the heart. List the layers of the heart wall. Be familiar with the following:
fibrous pericardium parietal pericardium visceral pericardium
pericardial cavity myocardium endocardium
15. Know the following structures of the heart.
R & L atria R & L ventricles atrial septum
ventricular septum atrioventricular valve tricuspid
bicuspid valve mitral valve semilunar valve
pulmonary valve aortic valve chordae tendineae

16. Be able to trace blood from the vena cava to the aorta. Be sure to include the valves in your answer. Describe how the valves keep the blood flowing in one direction. Know which vessels carry oxygenated and deoxygenated blood. Know which side of the heart pumps blood to the lungs and to the body.
17. Describe the steps of the cardiac cycle. Know when the atria and ventricles contract, when the valves open and close, and when the pressure rises and falls. Be familiar with the following:

atrial systole	ventricular filling	ventricular systole
ventricle diastole	lub sound	dup sound
heart murmurs		
18. Where are the blood vessels that bring nutrients to the myocardium?
19. Trace the conduction system of the heart. Be familiar with the following:

sinoatrial node	atrioventricular node	AV bundle
Purkinje fibers		
20. Describe what an electrocardiogram records. Be able to label the P, QRS, and T waves and explain what causes these waves.
21. Describe how parasympathetic and sympathetic stimulation alter the heart rate. Name the control center for heart rate and know where it is in the body. Be familiar with the following:

bradycardia	tachycardia
-------------	-------------
22. Know the definition of the 3 types of blood vessels. Do all arteries carry oxygenated blood?
23. Can nutrients diffuse in and out of all blood vessels? List 3 tissues that do not have capillaries.
24. Know the 3 layers found in the wall of blood vessels and the tissue types found there. Know that arteries have more smooth muscle than veins.
25. Describe the forces that cause the fluid to leave the capillaries (blood pressure) and cause fluid to be reabsorbed into the blood (osmotic pressure due to plasma proteins). Define the term edema and list 2 cause of edema.
26. Define blood pressure. List the approximate blood pressure of aorta, arterioles, capillaries, veins and right atrium. Define and list average values for systolic and diastolic blood pressure.
27. Describe how the following alter blood pressure:

heart rate	peripheral resistance
sympathetic stimulation	vasomotor center
constricting arterioles	relaxing arterioles
28. Describe the function of blood. List the pH of blood.
29. Know the average blood volume of men and women. List 3 types of formed elements and their function. Define hematocrit and give a normal value. Where is and what makes up the buffy coat?
30. Define plasma and serum. Discuss the function of the three types of protein found in plasma (albumin, globulins, and fibrinogen).
31. Describe the shape, color and function of erythrocytes.

32. Describe the process to make RBCs. Where do you find the red bone marrow in an adult? What is a reticulocytes? Where do you find them?
33. List the average life span of a RBC. Describe how old RBC are removed from the blood and recycled.
34. Describe how the rate of RBC production is elevated when oxygen delivery is low. Include the kidney and erythropoietin in your answer.
35. Discuss some dietary factors that cause anemia. Include factors that increase or decrease iron absorption, Vitamin B12 and folacin.
36. Describe how and where platelets are made. Give the average life span of a platelet.
37. Define hemostasis (not homeostasis). Do the platelets normally stick to each other? What is the role of collagen?
38. Describe the process of platelet plug formation. Do the platelets normally stick to each other? What is the role of collagen?
39. Describe the process of clot formation. Be sure to explain the role of:
prothrombin activator prothrombin thrombin
fibrinogen fibrin Ca

Study Guide for Lymph & Immune System

1. Describe the function of the various types of white blood cells. Know which cells are granulocytes and which are agranulocytes. For lab you will have to know the color of the granules. Know the percentage of WBC for each type of WBC, the approximate lifespan of granulocytes vs. agranulocytes, where WBCs are made, which WBCs can leave the blood stream and the function of each of the following:

neutrophils	eosinophils	basophils
monocytes	macrophages	lymphocytes
2. Describe the functions of the lymph system. List chemicals that you would expect to find in lymph.
3. Know the pathway of lymph flow. Include the parts of the body that drain into the right subclavian vein vs. the thoracic duct. Describe the anatomy of lymphatic capillaries.
4. Describe the function and anatomy of a lymph node. Where are lymph nodes found? Describe the function of the lymph organs: spleen, thymus gland and tonsils.
5. Describe the body's first and second line of defense. List the 4 systems that have a mucous membrane.
6. Describe the inflammation response including what causes the redness, heat, swelling and pain. Know which WBCs are part of the inflammation response.
7. Describe the function of antigens and antibodies. Explain how antibodies are specific for an antigen.
8. Describe the functions of B cells and T cells. Include where the cells develop and how they work. Include the following:

plasma cells	B memory cells	killer T cells
helper T cells	suppressor T cells	memory T cells
9. Describe the immune response to an antigen. How is this response different if the antigen returns a second time 2 years later?
10. What is a vaccine? Differentiate between passive and active immunity.
11. Describe how the blood typing system works including the antigens and antibodies present for type A, B, AB and O blood. Know which blood groups are compatible. Be able to explain HOW (step by step) to do a blood typing test. We did this in lab, but it will be on this lecture test.
12. Describe what is meant by an autoimmune disease. List 3 different autoimmune diseases.
13. Describe what is meant by an allergic reaction. List 5 common allergens. List several symptoms of an allergic response. What is anaphylactic shock and why can this be life-threatening?
14. Describe what is meant by digestion. How is this different than metabolism? Define the following: carbohydrates, fats and proteins.
15. Know which organs are part of the digestive system and which are accessory organs.

16. Be familiar with the four layers that make up the wall of the digestive system. Know the types of tissues and structures found in each layer.
- | | | | |
|---------------------------------|-----------|------------|--------|
| mucosa | submucosa | muscularis | serosa |
| circular & longitudinal muscles | | | |
17. Describe the mechanical digestion of food in the mouth. Be familiar with the following:
- | | | |
|----------------------|-------------------|----------------|
| mastication | tongue | papillae |
| taste buds | teeth | gingivae |
| crown | roots | enamel |
| dentin | pulp cavity | parotid glands |
| submandibular glands | sublingual glands | saliva |
| mucus | | |
18. Describe the process of deglutition or swallowing. Include how the epiglottis and larynx move to prevent food from entering the trachea.
19. List the type of tissue that makes up the lining of the esophagus. Describe the process of peristalsis.
20. Describe the function of the stomach. Define chyme. List 3 chemicals that the gastric glands make.
21. List the type of tissue that makes up a sphincter. What is the function of sphincter? List the 2 sphincters of the stomach.
22. What is the function of the small intestines? Be familiar with the following:
- | | | |
|----------|----------------|--------------|
| duodenum | jejunum | ileum |
| villi | columnar cells | microvilli |
| lacteals | capillaries | goblet cells |
23. List the main functions of the large intestines. Be familiar with the following:
- | | | |
|--------|-----------------|-----------------|
| rectum | inner sphincter | outer sphincter |
|--------|-----------------|-----------------|
24. Describe the function of the liver. Review the portal blood system. Be familiar with the following:
- | | | |
|-----------------|-----------------|------------------|
| bile | bile canaliculi | small bile ducts |
| gallbladder | cystic duct | common bile duct |
| sphincter at SI | | |
25. Describe how the liver makes bile. Know the difference between :
- | | | |
|----------------|----------------------|------------|
| free bilirubin | conjugated bilirubin | bile salts |
|----------------|----------------------|------------|
26. Know the following about the pancreas:
- | | | |
|----------|-------------------|--------------------|
| location | exocrine function | endocrine function |
|----------|-------------------|--------------------|

16. Describe how the medulla and pons regulate breathing rate. Describe the function of the following:
- | | | |
|------------------|-----------------|---------------|
| inspiratory area | expiratory area | phrenic nerve |
|------------------|-----------------|---------------|
17. Describe other factors that alter breathing rate including:
- | | | |
|-----------------|-------------------|-----------------|
| cerebral cortex | stretch receptors | CO ₂ |
| carotid bodies | aortic bodies | |
18. Describe the response to high CO₂ and low CO₂.
19. Know what type of cells line the lungs and capillaries
20. Be able to trace O₂ and CO₂ from the lungs to the cells and back to the lungs. Know where the PO₂ and PCO₂ are highest and lowest. KNOW the value of PO₂ and PCO₂ in ARTERIAL blood.
21. Describe how O₂ is carried in the blood. List different conditions that causes O₂ to separate from hemoglobin (low O₂, acidic pH, and high temperature).
22. Describe the 3 ways CO₂ is carried in blood. Be able to describe the reactions converting CO₂ to bicarbonate and H⁺.
23. Describe how bicarbonate is used as a buffer. Describe what happens if we have too much acid or not enough acid in the blood.

Study Guide for Renal System

1. List several functions of the kidneys. Do not list making urine!!!
2. Give the route by which urine travels from the kidneys to outside the body.
3. Know the following:

hilum	cortex	medulla
renal pyramids	renal papilla	renal pelvis
minor calyces		
4. Know how much blood flows to the kidneys. Know the following vessels (arteries and veins):

renal	interlobar	arcuate	interlobular
-------	------------	---------	--------------
5. Know the parts of a nephron and the associated blood vessels. Include the following:

glomerular capillaries	glomerular capsule	proximal tubules
loop of Henle	distal tubules	collecting duct
afferent arteriole	efferent arteriole	peritubular capillaries
6. Describe how the filtrate is made in the glomerulus. Discuss the importance of the pores in the capillaries. Be able to list the pressures involved with filtration. Know how much filtrate we make a minute. List 3 chemicals that are filtered and 2 chemicals (or cells) that are not filtered.
7. List 4 chemicals that are reabsorbed at the proximal tubules.
8. Know the function of the loop of Henle. This includes reabsorbing water, sodium, chlorine and making the extracellular fluid more concentrated.
9. Describe the reabsorption of water from the collecting duct. Describe the effect of anti-diuretic hormone (ADH) on the collecting duct. List where ADH is made and what inhibits ADH release.
10. Is there a limit on how concentrated the urine can become? List the minimum and typical urine productions. List 3 other ways we lose water from the body.
11. List where glucose is reabsorbed. Describe what is happening if there is glucose in the urine.
12. Describe what is meant by tubular secretion. List substances that are secreted.
13. Describe the action of aldosterone on the kidneys. List where aldosterone is made and what triggers its release.
14. Know what each of the following wastes come from:

urea	uric acid	creatin
------	-----------	---------
15. Be familiar with the following components of the renin-angiotensin system. Know where each of these are made or is found.

renin	angiotensinogen	angiotensin I
angiotensin II	angiotensin converting enzyme	
16. Describe 3 actions of angiotensins II. Be able to start with a fall in blood pressure and trace the actions of angiotensin II and aldosterone to increase blood pressure.
17. Describe the structure of the bladder. List the 4 layers in the bladder wall and know the type of tissue there. Know the detrusor muscle and where the internal and external sphincters are.

18. Know how much urine the bladder can hold and when it feels full. Describe the process of micturation.
19. Describe the normal characteristics of urine. Include pH, color and specific gravity.

Endocrinology

1. Describe general differences between the nervous system and the endocrine system.
2. Define the term hormone. Why do hormones only affect their target tissues and not all organs and tissues?
3. Be able to define hormones as steroids or nonsteroidal. Describe the differences between the slow acting hormones (steroids & thyroid) and fast acting hormones (nonsteroidal). Why are the slow acting hormones so slow?
4. Describe what is meant by a second messenger. Which hormones use a second messenger? Describe how cyclic AMP is used as second messenger.
5. Describe the function of antidiuretic hormone (review info from kidney) and oxytocin. Does the posterior pituitary make these hormones?
6. Describe the interaction between the hypothalamus and the anterior pituitary. Be familiar with the following:

thyroid-stimulating hormone	adrenocorticotropin hormone
follicle-stimulating hormone	luteinizing hormone
prolactin	growth hormone
thyroid-releasing hormone	corticotropin releasing hormone
gonadotropin releasing hormone	growth hormone releasing hormone
prolactin releasing hormone	somatostatin
prolactin-inhibiting hormone	
7. Describe the functions of growth hormone. This includes both growth and metabolic effects. List factors that stimulate growth hormone release. Include the following:

dwarfism	gigantism	epiphyseal plates
acromegaly	protein synthesis	fatty acid usage
glucose usage		
8. Describe the functions of prolactin in women.
9. Describe the structure of the follicles in the thyroid. Know that iodine is necessary to make thyroid hormone.
10. Describe the effects of thyroid hormone. Describe how the following are effected by thyroid hormone:

glucose uptake	oxygen utilization	protein synthesis
growth	fatty acid usage	heart rate
nervousness		
11. Describe the regulation of thyroid hormone release. Include the following:

thyroid releasing hormone (from hypoth)	thyroid stimulating hormone (from pit)
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12. Describe the following conditions: goiter, hyperthyroidism, hypothyroidism.
13. Review the structure on bone. List the functions of osteoblasts and osteoclasts.
14. The 3 hormones that regulated Ca levels in blood are parathyroid hormone, Vitamin D and calcitonin. Describe the function of each of these. Know the specific organs that they act as. Know what regulates the secretion of each of these also.

15. List the hormones that are made by the adrenal medulla. Review the functions of epinephrine and norepinephrine.
16. List the 3 divisions of the adrenal cortex (glomerulosa, fasciculata & reticularis) and the types of hormones they produce (mineralcorticoids-aldosterone, glucocorticoids-cortisol, sex steroids). Review the functions of aldosterone and its effects on the kidney.
17. Describe the functions of the glucocorticoids - cortisol. How does it alter glucose metabolism? If we are low on glucose, what can we make glucose from? What stimulates cortisol release? What are the side effects of prolonged high levels of cortisol?
18. List the 2 hormones made by the pancreas. Know the functions of each of these hormones.
19. List the functions of estrogen in the body. Include the effects on the osteoblasts, epiphyseal plates, secondary sex characteristics, and protein synthesis.
20. Describe the function of progesterone in the body. Note that these functions are different than estrogen's.
21. Be able to describe the secretion of FSH, LH, estrogen and progesterone during a menstrual cycle. Know what day LH values peak.
22. Describe the ovarian cycle. Be familiar with the following:

germ cells	mitosis	primary oocytes	follicular cells
meiosis	polar body	ovulation	corpus luteum
follicular stage	luteal stage		
23. Describe the changes in the uterine wall during the uterine cycle. List which hormones cause these changes.
24. Describe what hormonal changes must happen to maintain a pregnancy. Describe the function of human chorionic gonadotropin.
25. Know that both male and female fetuses start with the same basic anatomy. With testosterone it becomes a male, without testosterone it is a female.
26. List the functions of testosterone in the body. Include effects on the osteoblasts, epiphyseal plates, secondary sex characteristics, and protein synthesis.
27. Be familiar with the following terms:

spermatogenesis	seminiferous tubules	germinal cells
interstitial cells of Leydig		
28. Describe the process of spermatogenesis. Define the following terms:

spermatogenesis	meiosis	sperm
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 Know how long this process takes. Describe why the testes are outside the body.
29. List 4 glands that make semen. What is a normal sperm count?
30. Trace the path of sperm from the seminiferous tubules to the outside world.
31. Describe the function of testosterone, FSH, and LH.

Study Guide for the Comprehensive Final

There will be a combination of multiple choice, matching and written questions covering the comprehensive material.

1. List the 4 categories of organic chemicals (carbohydrates, lipids, proteins, and nucleic acids). For each list 2 examples and their functions.
2. Know what it means if something is lipid-soluble or water-soluble. List 2 molecules for each of these. Which of these can be added to the blood, and which can cross the cell membrane?
3. Review osmosis. Know what the terms isotonic, hypertonic and hypotonic mean. Be able to describe what happens if a RBC is put into a hypertonic or hypotonic solution.
4. List the 4 tissue types (epithelial, connective, muscle and nerve) and all the types of epithelial cells (simple squamous, cuboidal, columnar, stratified squamous, and transitional) and connective tissue (loose CT, adipose, dense CT, hyaline cartilage, and blood). For each of these give an example of where it is found in the body.
5. Describe why calcium is important for the body. Include where it is stored and 2 different processes that depend on calcium.
6. List normal values for heart rate and blood pressure. What do the systolic and diastolic numbers represent? Be able to trace blood going through the heart including the names of the blood vessels and valves. When do the valves open and close?
7. List and give the function of the 3 types of blood cells (erythrocytes, leukocytes and thrombocytes). List and give the function of the 5 types of leukocytes. Which types are more prevalent?
8. Review how B cells and T cells work. Be familiar with antigens and antibodies.
9. Describe how the blood typing system works including the antigens and antibodies present for type A, B, AB and O blood. Know which blood groups are compatible.