Name: ___________________________ Lab Time: ______

The Cell

Physiology Study Guide, Chapter 3

List of medical roots, suffixes and prefixes

<table>
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<th>Term</th>
<th>Meaning</th>
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<th>Term</th>
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<td>a-</td>
<td>without</td>
<td>atrophy</td>
<td>meta-</td>
<td>after, beyond</td>
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<td>auto-</td>
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<td>autophagy</td>
<td>neo-</td>
<td>new</td>
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<tr>
<td>-cyte, cyto-</td>
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<td>-elle</td>
<td>small</td>
<td>organelle</td>
<td>-philic</td>
<td>loving</td>
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<tr>
<td>homo-</td>
<td>same</td>
<td>homologous</td>
<td>-phobic</td>
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<tr>
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<td>water</td>
<td>hydrostatic</td>
<td>-plasm</td>
<td>formed, molded</td>
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<tr>
<td>hyper-</td>
<td>above</td>
<td>hypertonic</td>
<td>-some</td>
<td>body</td>
<td>lysosome</td>
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<td>hypo-</td>
<td>below</td>
<td>hypotonic</td>
<td>-stasis</td>
<td>stand, stay</td>
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<tr>
<td>iso-</td>
<td>equal, same</td>
<td>isotonic</td>
<td>-trophic</td>
<td>nourish</td>
<td>hypertonic</td>
</tr>
<tr>
<td>lyso-</td>
<td>dissolving</td>
<td>lysosome</td>
<td>-trophic</td>
<td>nourish</td>
<td>hypertrophy</td>
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Part I. Clinical Applications

1. Johnny lacerated his arm and rushed home to Mom so she could “fix it”. His mother poured hydrogen peroxide over the area, and it bubbled vigorously where it came in contact with the wound. Because you can expect that cells were ruptured in the injured area, what do you think was happening here?

The catalase from the ruptured cells (mainly from their peroxisomes) are converting the hydrogen peroxide to water and free oxygen gas (which causes the bubbling). Hydrogen peroxide is used as a potent antimicrobial agent when cells are infected with a pathogen. Many kinds of bacteria do not produce catalase and are destroyed by the hydrogen peroxide.

2. Your friend tells you that he is taking the antibiotic streptomycin for an infection. He wants to know how this particular antibiotic can kill bacterial cells but not kill his own cells. What is your explanation?

Streptomycin inhibits bacterial protein synthesis by interfering with ribosomal function of bacteria and has no effect on the ribosomes of humans. If the bacterial are unable to synthesize new protein (many of which would be essential enzymes), they will die.

3. Sarah, a trainee of the electron microscopist at the local hospital is reviewing some micrographs of muscle cells and macrophages (phagocytic cells). She notices that the muscle cells are loaded with mitochondria while the macrophages have abundant lysosomes. Why is this so?

Mitochondria are the site of most ATP synthesis, and muscle cells use tremendous amounts of ATP during contraction. After ingesting bacteria or other debris, phagocytes must digest them, explaining the abundant lysosomes.

4. In normally circulating blood, the plasma proteins cannot leave the blood stream easily and, thus, tend to remain in the blood. But if stasis (blood flow stoppage) occurs, the proteins will begin to leak out into the interstitial fluid. Explain why this leads to edema (water buildup in the tissues).

Edema will occur because the filtration pressure exerted by the blood forces blood proteins (mainly albumins) into the interstitial space. This increases the solute concentration of the interstitial space and water moves down its concentration gradient by osmosis from the plasma to the interstitial space resulting in edema.
5. You overhear a group of teenagers betting each other as to who could drink the most water within a 15 minute time span. Being the excellent medical student that you are you interrupt them and explain the dangers of drinking seemingly harmless liquid (water) in such a short period of time. What is your explanation?

   Drinking water is hypotonic to the cells of your body. Taking in too much water in a short period of time will cause the blood and eventually the interstitial fluid to become hypotonic to the body cells. The extracellular water will then move by osmosis into the body cells and cause them to rupture. This could, and has in the past, kill a person.

6. Some pediatricians recommend the use of a 10% salt solution to relieve congestion for infants with stuffy noses. What effect would such a solution have on the cell lining the nasal cavity, and why?

   The 10% salt solution would be hypertonic with respect to the cells lining the nasal cavity, because this solution contains a higher concentration of salt than do the cells. The hypertonic solution would draw water out of the cells, causing the cells to shrink and adding water to the mucus, thus relieving the congestion.

7. An instructor at the fitness center tells you that bodybuilders have the potential for increased supplies of energy and improved muscular performance because of increased numbers of mitochondria in their muscle cells. Is this correct? Why or why not?

   Yes, it is correct. Mitochondria contain RNA, DNA, and enzymes needed to synthesize proteins. Mitochondria control their own maintenance, growth and reproduction. The muscle cells of bodybuilders have high rates of energy consumption and over time their mitochondria respond to increased energy demand by reproducing and providing more mitochondria and increased energy production.

8. One remedy for constipation is a saline laxative such as Epsom salts (MgSO4). Why do such salts have a laxative effect?

   Epsom salts increases the solute concentration in the lumen of the large intestine making the intestine hypertonic to surrounding tissues. The osmosis of water occurs from the surrounding tissues into the intestinal lumen. The fluid helps soften the stool and the watery environment prepares the intestine for eventual evacuation of the stool from the bowel.

9. In a hospital, a nurse gave a patient recovering from surgery a transfusion of 5% salt solution by mistake instead of a transfusion of physiological saline (0.9% salt). The patient quickly went into shock and soon after died. What caused the patient to enter into a state of shock and die?

   Because of the increase of solute concentration in the blood stream, it became hypertonic to the RBCs. The RBCs dehydrated and shrank – crenation. The crenated RBCs lost their oxygen-carrying capacity and the body tissues were deprived of the oxygen necessary of cellular metabolism to support life.
10. A hard working student of physiology was preparing a tossed salad in the afternoon for the evening meal. The vegetables to be used were placed in a bowl of cold water in order to keep these vegetables crisp. Osmotically speaking, explain why the vegetables remain crisp.

The vegetables contain greater solute concentration than does the watery environment surrounding them. Since the watery environment is hypotonic to the cells of the vegetables, the osmosis of water into the vegetables causes crispness, or turgidity.

11. Ellie’s dad tells her that his fingers used to wrinkle up when he went swimming in Lake Michigan (fresh water) as a boy. Her mom tells her that never happened when she went swimming at the Great Salt Lake in Utah when she was a girl. Using your knowledge of osmosis explain why the skin of the fingers wrinkles in fresh water but not in salt water.

Lake Michigan is a freshwater lake with lower osmolarity than human tissue (i.e., It is hypotonic to the water in human tissue). Exposure to fresh water causes movement of water by osmosis, into the digital pulp vasculature via the sweat glands. The increased water volume causes a decrease in electrolyte concentration within digit pulp tissues and stimulates increased firing rates of the sympathetic nerve fibers causing vasoconstriction. The vasoconstriction of the digital pulp results in loss of pulp volume which results in the skin wrinkling. Specifically, the vasoconstriction shrinks the glomus bodies (arterio-venous connection surrounded by a capsule of connective tissue) within the digital pulp resulting in a loss of pulp volume. Note: The dermis of the hands and feet have the highest concentration of glomus bodies. As the glomus bodies shrink its connective tissue fibers that are attached to the epidermis pull on the epidermis giving the skin a wrinkled appearance. The wrinkling is thought to improve grip in a watery environment. The wrinkling is thought to improve grip in a watery environment.

Connection of wrinkled skin to limb sympathetic function was first established when patients with either central (or peripheral) lesions of the sympathetic pathways were shown to lose the ability to wrinkle on exposure to water.

The Great Salt Lake has a higher concentration of dissolved particles than the human body. By osmosis, there is a net movement of water out of the skin rather than into the skin and over time, the person can become dehydrated. This is the main reason that people lost at sea can die of thirst or dehydration if they are in or drink salt water for an extending time.
Part II
1. Glycoprotein
2. Integral protein
3. Cholesterol
4. Peripheral protein
5. Integral protein with pore
6. Simple diffusion
7. Filtration
8. Facilitated diffusion
9. Osmosis
10. low; high
11. ATP
12. Phagocytosis, Pinocytosis (bulk-phase), Receptor mediated endocytosis
13. Phagocytic vesicle
14. Receptor mediated endocytosis

Part III
1. Cell (plasma) membrane
2. Cytoplasm
3. Nuclear envelope (membrane)
4. Nucleolus
5. Nucleus
6. Lysosome
7. Centrosome
8. Centrioles
9. Microtubule network
10. Microvilli
11. Cilia
12. Secretory vesicles
13. Golgi apparatus (body)
14. Smooth endoplasmic reticulum (SER)
   A. Mitochondria
   B. Ribosome (attached to RER)
   C. Free ribosome
   D. rough endoplasmic reticulum (RER)
15. F
16. T
17. F
18. F
19. T
20. F
21. mitosis, somatic cell division
22. meiosis, reproductive division
23. cytokinesis
24. anaphase
25. prophase
26. metaphase
27. telophase
28. leukemia
29. sarcoma
30. lymphoma
31. osteogenic sarcoma
32. melanoma
33. carcinoma
34. neoplasm; malignant; benign
35. malignant; metastasis
36. meiosis; mitosis
37. cytokinesis; mitosis

Part IV
1. RER
2. SER
3. SER
4. golgi complex
5. lysosome
6. mitochondria
7. microfilaments
8. microtubules
9. centrioles
10. flagella
11. cilia
12. SER
13. mitochondria
14. cilia
15. golgi
16. lysosomes
17. simple diffusion
18. facilitated diffusion
19. osmosis
20. pinocytosis (bulk-phase endocytosis)
21. phagocytosis
22. exocytosis
23. D
24. B
25. more; fewer
26. A
27. out of; crenate
28. Iso
29. Isotonic; Hypotonic to Isotonic (depending on severity). An isotonic solution is 0.9% NaCl or 5% glucose. A hypotonic solution will be less.
30. C
31. A
Part V
1. Exocytosis, phagocytosis, pinocytosis, receptor-mediated endocytosis
2. simple diffusion, osmosis, facilitated diffusion
3. filtration
4. simple diffusion, osmosis, facilitated diffusion
5. active transport
6. simple diffusion
7. active transport
8. exocytosis, phagocytosis, pinocytosis, receptor-mediated endocytosis
9. phagocytosis
10. exocytosis
11. facilitated diffusion
12. Somatic cells
13. G1
14. G2
15. Mitosis
16. DNA Replication
17. Metaphase
18. Telophase
19. cytokinesis
20. chromatin
21. chromatids
22. centromeres
23. centrosomes or centrioles
24. prophase
25. anaphase
26. telophase
27. telophase
28. metaphase
29. prophase
30. prophase
31. S
32. prophase
33. Prophase
34. telophase/cytokinesis
35. anaphase; metaphase
36. Go
37. C
38. B
39. B
40. A
41. C
42. A

Part VI
1. extracellular fluid
2. cilia
3. cell membrane
4. integral proteins
5. channels
6. phospholipid
7. peripheral proteins
8. intracellular fluid
9. ions
10. proteins
11. cytoskeleton
12. organelles
13. cytosol
14. nonmembranous
15. protein synthesis
16. cell division
17. mitochondria
18. cristae
19. matrix
20. respiratory enzymes
21. ATP
22. nucleus
23. nuclear envelope
24. nuclear pores
25. nucleoli
26. ribosomes
27. nucleoplasm
28. chromosomes
29. endoplasmic reticulum
30. rough endoplasmic reticulum
31. golgi apparatus
32. saccules
33. A (Moves into the sac)
34. B (Moves out of the sac)
35. C (Does not move)
36. A (Moves into the sac)
37. A; crenated
38. B; The same solute concentration inside and outside the cell
39. C; Movement of water into the cells due to osmosis
Part VII
1. Proteins 7. complementary 13. template or model
2. helix 8. cytosine 14. new
3. phosphate 9. thymine 15. old
4. sugar 10. ribosome 16. genes
5. bases 11. replication 17. growth
6. amino acids 12. nucleotides 18. repair

Part VIII
1. nucleus 12. nucleus 24. C
2. cytoplasm 13. gene 25. D
4. centromeres 15. ribosomes 27. B
5. binucleate cell 16. endocytosis 28. D
6. spindle 17. osmosis 29. C
7. Interphase or more 18. interphase (Go of 30. Question
specifically, Go of 31. D
Interphase 19. anaphase 32. C
8. phospholipid bilayer 20. differentiation 33. D
9. cytoskeleton 21. A 34. C
10. fixed ribosomes 22. B 35. E
11. nuclear pores 23. B 36. C

Part IX Intravenous Solutions
9. C 18. C

Part X Extra Credit Questions
1. In kidney dialysis, a person’s blood is passed through a bath that contains several ions and molecules. The blood is separated from the dialysis fluid by a membrane that allows water, small ions, and small molecules to pass, but does not allow large proteins or blood cells to pass. What should the composition of dialysis fluid be for it to remove urea (a small molecule) without changing the blood volume (removing water from the blood)?

   For the dialysis fluid to remove urea, it should not contain urea. Because urea is a small molecule, it will diffuse through the dialysis membrane from an area of high concentration (the blood) to an area of low concentration (the dialysis fluid). To prevent associated water movement, the dialysis fluid should have an osmotic concentration similar to that of blood plasma by with higher concentrations of solutes such as bicarbonate ions or glucose. As urea diffused into the dialysis fluid, glucose and bicarbonate diffuse into the blood. As a result, the solute concentrations remain in balance and no osmotic water movement occurs.

3. D 5. D
Part IX IV Solutions

1. Term used to describe the number of osmotically active solute particles (ions or molecules) per liter (L) of water.
   A. molarity    B. mole    C. Avogadro’s number    D. molality    E. osmole

2. The difference between osmolarity and tonicity is that osmolarity is based solely on its total solute concentration (permeating solutes and non-permeating solutes), whereas tonicity is based on how the solution affects cell volume, which depends only on the concentration of non-permeating solutes.
   A. The above statement is true    B. the above statement is false

3. The pressure that needs to be applied to a solution to prevent osmosis – that is, stops the net flow of water across a semipermeable membrane is known as
   A. oncotic pressure    B. hydrostatic pressure    C. osmotic pressure    D. blood pressure

4. Which of the following is a normal serum osmolarity for an adult patient?
   A. 245 mOsm/L    B. 285 mOsm/L    C. 352 mOsm/L    D. 385 mOsm/L    E. 395 mOsm/L

5. Which of the following osmolarities would cause fluid to move out of cells?
   A. 235 mOsm/L    B. 250 mOsm/L    C. 275 mOsm/L    D. 385 mOsm/L    E. 295 mOsm/L

6. Intracellular fluid makes up about how much of total body water?
   A. ¼    B. 1/3    C. ½    D. 2/3    E. ¾

7. A unit of measurement that equals $6.02 \times 10^{23}$ particles (atoms, molecules, ions or electrons).
   A. mole    B. dozen    C. kilogram    D. liter    E. deciliter

8. Term used to describe the number of osmotically active solute particles (ions or molecules) per kilogram (kg) of water.
   A. molarity    B. mole    C. Avogadro’s number    D. molality    E. osmole

9. What is the osmolality of sodium sulfate (Na$_2$SO$_4$) which dissociates into 2 Na$^+$ and 1 SO$_4$$^{\text{-}}$?
   A. 1 Osm    B. 2 Osm    C. 3 Osm    D. 4 Osm    E. 2.5 Osm

10. Which of the following is a form of osmotic pressure exerted by proteins, notably albumin, in a blood vessel's plasma (blood/liquid) that usually tends to pull water into the circulatory system.
    A. blood pressure    B. hydrostatic pressure    C. barometric pressure    D. oncotic pressure

11. A patient who had a recent surgery has been vomiting and becomes dizzy while standing up to go to the bathroom. Their blood pressure is 55/30 and the pulse is 140 beats per minute. Which of the following IV fluids could be used to correct the condition?
    A. D50W .045 NS    B. 0.9 NS    C. 0.45 NS    D. 0.33 NS

12. Which of the following osmolarities would cause fluid to move into cells?
    A. 245 mOsM    B. 285 mOsM    C. 352 mOsM    D. 385 mOsM    E. 308 mOsM

13. Which of the following best approximates the osmolarity of normal saline (0.9% NaCl)?
    A. 245 mOsM    B. 255 mOsM    C. 352 mOsM    D. 385 mOsM    E. 308 mOsM

14. Which of the following IVs would be considered hypertonic?
    A. D5W    B. NS    C. 0.45 NS    D. 0.33 NS    E. D5WNS

15. Which of the following describes the term “isotonic”?
A. A solution that has the same concentration of sodium as does the cell
B. The natural tendency for substances to flow from an area of higher water concentration to an area of lower water concentration.
C. A solution that has a higher concentration of potassium than does the cell
D. A solution that has a lower concentration of sodium than the cell.

16. Which of the following solutes is the greatest contributor to the osmolality of fluid?
   A. sodium  B. water  C. potassium  D. calcium  E. magnesium

17. Which of the following solutions has a greater concentration of solutes than blood
   A. isotonic  B. hypertonic  C. hypoosmolar  D. hypotonic  E. 0.45 NS

18. Which of the following mechanisms is the most important regulator of fluid intake?
   A. electrolytes  B. kidneys  C. thirst  D. renin-angiotensin  E. hunger

19. If a patient has hyponatremia, which of the following IVs should be used?
   A. D5W  B. 0.9% NaCl  C. Dextran 40  D. albumin  E. D50W with KCl

20. Which of the following IV solutions is the most physiologically adaptable fluid because its electrolyte composition is most related to the composition of blood plasma.
   A. 0.9% NaCl  B. lactated ringer’s  C. D10W  D. D5W  E. albumins

21. Which of the following IVs would be used to treat patients with intracellular dehydration as can occur in hypernatremia, diabetic ketoacidosis, or hyperglycemic state?
   A. 0.45% NaCl  C. D50W  
   B. 0.33 % NaCl  D. Solution of 250 mOsm/L  E. A, B, and D are correct

22. Which of the following IVs would be used to treat a patient with cerebral edema in order to raise plasma osmolarity and draw water out of the intracellular and interstitial space?
   A. 3% sodium chloride  B. D5WNS  C. Solution of 375 mOsm/L  D. all of these are correct

23. You are going to order a hypotonic IV for a patient with cellular dehydration. Which of the following would be administered.
   A. 0.9% saline  B. 10% dextrose in NS  C. LR’s  
   D. 0.45% sodium chloride

24. You are getting ready to transfuse one unit of red blood cells. Prior to hanging the blood from the IV stand you will prime the blood tubing with which solution?
   A. 5 % dextrose  B. Lactated Ringers  C. 0.9% NaCl  
   D. D5W in 0.45% NaCl

25. A patient’s blood test reveals metabolic acidosis. Which of the following should be administered to correct the metabolic acidosis?
   A. Sodium chloride  B. ammonium chloride  C. sodium bicarbonate  
   E. KCl

26. Which of the following IV solutions could be used to increase blood volume following severe hemorrhage, loss of plasma (burns), and hypovolemic shock?
   A. D5W  B. 0.45% NaCl  C. dextran  D. albumin  E. Both C and D