

Supplemental Material

CBE—Life Sciences Education

Leupen *et al.*

Human Physiology
Prior Knowledge Survey
August, 2017

Name: _____

Correct answers are bolded.

I. Multiple Choice

1. (Net) osmosis will occur:

- a) from hyperosmotic to hyposmotic solutions
- b) toward the higher concentration of nonpenetrating solutes**
- c) toward the lower concentration of penetrating solutes
- d) between any two isosmotic solutions

2. What is the primary cause of the resting membrane potential in the body's cells?

- a) the action of the sodium-potassium pump
- b) potassium leaving the cell through its leak channels**
- c) sodium entering the cell through its voltage-gated channels
- d) chloride entering the cell through K^+/Cl^- cotransporters

3. Histamine is a chemical released from mast cells at sites of injury that (among other functions) causes increased capillary permeability at the site of injury. In this case, histamine is acting as a:

- a) hormone
- b) autocrine
- c) paracrine**
- d) neurotransmitter

4. Myelination of an axon increases the speed of action potential propagation by:

- a) increasing the number of action potentials that can occur in a given length of axon membrane
- b) increasing the capacitance of the axon membrane underneath the myelin
- c) preventing ions from traveling through the cytoplasm of the axon in between nodes
- d) decreasing the permeability of the axon membrane to ions to almost zero between the nodes**

5. The optic nerve carries information from the eyes to the brain. It is a _____ nerve:

- a) sensory**
- b) motor
- c) mixed
- d) spinal

6. After an action potential:

- a) the Na^+ and K^+ concentration gradients have been dissipated and must be “recharged” by the Na^+/K^+ pump before another action potential is possible
- b) the Na^+ and K^+ concentration gradients have been partially dissipated, which decreases the amplitude but not the frequency of additional action potentials
- c) the Na^+ gradient has been temporarily dissipated, but the K^+ gradient has not changed
- d) the Na^+ and K^+ concentration gradients are approximately the same as they were before the action potential**

7. Which is a major function of the medulla oblongata?

- a) regulating hormone release
- b) regulating breathing rate**
- c) monitoring blood pressure
- d) relaying sensory information to the cerebral cortex

8. In sensory physiology, “accommodation” refers to:

- a) the decreased firing rate of some types of sensory receptors in response to a constant stimulus
- b) the changing shape of the lens in the eye when focusing on a nearby object**
- c) the bleaching of photoreceptors that occurs after a several seconds of constant stimulus, that gives rise to after-images
- d) the recruitment of additional receptive fields to respond to a stimulus, such as in somatosensation

9. You pick up a book, set it down and pick up two books. What allows you to use more force the second time?

- a) Greater action potential frequency in the motor neuron
- b) More Ca^{++} released per AP and therefore more cross-bridges formed
- c) Increased ATP production rate in each participating muscle fiber
- d) More motor units participating in the movement**

10. In a contracting skeletal muscle, which is correct?

- a) myosin and actin fibers each get shorter
- b) myosin and actin fibers become more overlapped with each other**
- c) myosin and actin fibers become twisted or braided together
- d) myosin and actin fibers stretch, so they are temporarily longer

11. An elite sprinter probably has:

- a) mostly slow-twitch oxidative muscle fibers with lots of mitochondria
- b) mostly slow-twitch oxidative muscle fibers with lots of glycolytic enzymes
- c) mostly fast-twitch glycolytic muscle fibers with many capillaries
- d) mostly fast-twitch glycolytic muscle fibers with relatively few mitochondria**

12. Why do we need oxygen?

- a) to exchange with carbon dioxide molecules in order to rid our bodies of that toxin
- b) as a cofactor in the reaction that converts ATP to ADP + Pi
- c) as the final electron acceptor in the electron transport chain**
- d) to catalyze oxidation-reduction reactions in the cytoplasm of tissue cells

13. Which of the following is correct about breathing in (inhaling)?

- a) the lungs expand, which makes the pressure in them lower, which makes air enter the lung from outside**
- b) the air enters the lungs from outside, which makes the lungs expand, which makes the pressure in them lower
- c) the air enters the lungs from outside, which makes the pressure in them higher, which makes the lungs expand
- d) the pressure in the lungs decreases, which makes the lungs expand, which makes air enter the lung from the outside

14. Micturition is a synonym for:

- a) secretion of breast milk/breastfeeding
- b) urination**
- c) sweating
- d) ovulation

15. Which is a major function of the pancreas?

- a) acting as a site of absorption for macronutrients, especially carbohydrates
- b) releasing glucose into the blood when blood levels are too low
- c) producing digestive enzymes for use in the small intestine**
- d) producing bile

16. Which is a major function of the liver?

- a) acting as a site of absorption for macronutrients, especially carbohydrates
- b) producing bile**
- c) producing digestive enzymes, especially lipases, for use in the small intestine
- d) producing buffers that are released into the small intestine to neutralize the acidic pH of the chyme

17. I had the chicken pox when I was six, so I am essentially unable to ever become ill from it again. Why is this—what will happen if I am exposed to chicken pox?

- a) it will be unable to enter my body
- b) it will be destroyed by antibodies that have been continuously produced in my blood since my initial exposure
- c) it will be destroyed by lymphocytes activated by memory cells' recognition of this virus**
- d) it will be destroyed directly by the memory lymphocytes which recognize the virus

18. The HIV virus targets the host's helper T cells, leading to their 'hijacking' as well as destruction. This is dangerous because without helper T cells:

a) the inflammatory response cannot be triggered

b) lymphocytes are not stimulated to undergo clonal expansion in response to a pathogen

c) the acquired or adaptive immune response cannot be terminated, leading to a chronic state of energy-intense "high alert" status in the immune system

d) platelets, red blood cells and other self-cells cannot be defended against attack by the body's own B and T cells

19. What is a correct statement about the prostate gland?

a) sperm pass through it on their way from the epididymis to the urethra

b) it produces sugars and enzymes that contribute to semen

c) it protects developing and stored sperm from "attack" by the immune system

d) it is required for the erection reflex

20. What is the corpus luteum?

a) the most superficial layer of endometrium, that is periodically shed during menstruation

b) the "leftover" ovarian follicle, minus the ovulated egg, that secretes progesterone

c) the collective name for an egg and its "groupie" follicle cells that nurture the developing oocyte

d) the organ produced as a "joint project" of the fetus and mother that secretes hormones and passes nutrients and wastes from the mother to fetus

II. Short Answer

1. List the organs of the GI tract (alimentary canal) in order from mouth to anus.

oral cavity → pharynx → larynx → esophagus → stomach → small intestine → large intestine → rectum → anus

2. What are the major functions of the kidneys-- what is the kidney FOR? There's more than one, so write as many as you can think of.

Maintaining blood volume and blood pressure

Regulating blood pH

Regulating total blood osmolarity

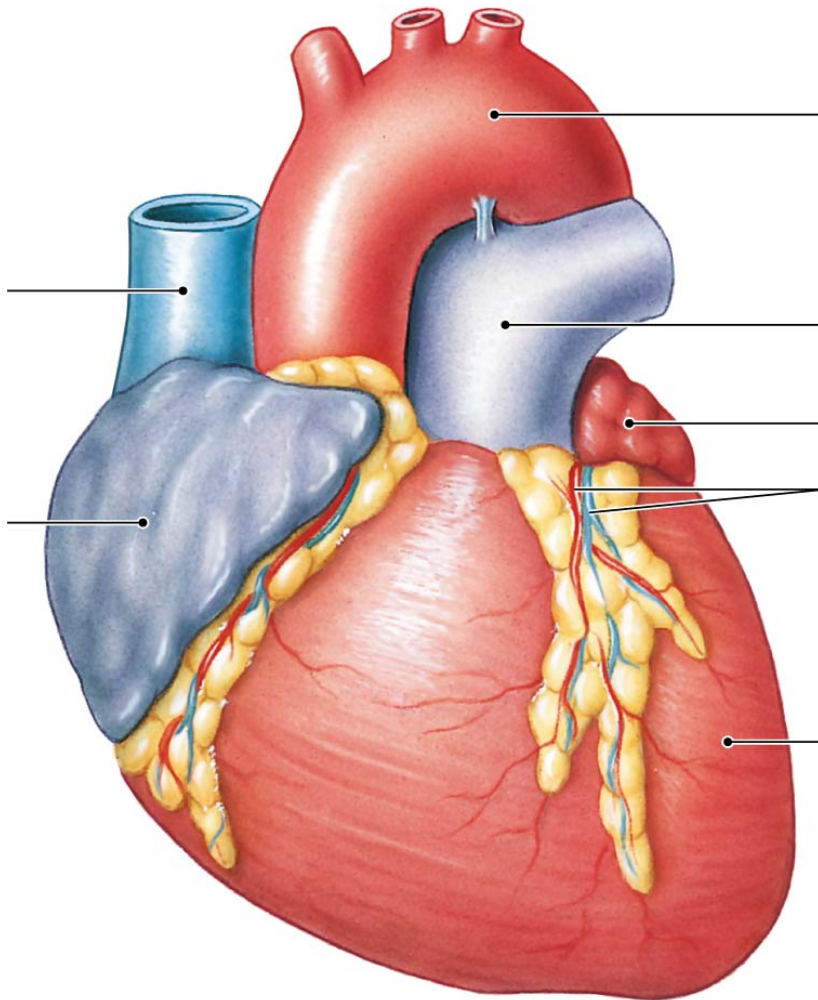
Regulating specific ion concentrations in the blood

Producing hormones including erythropoietin and renin
Removal of waste products including metabolic wastes and xenobiotics

3. If a woman had a scheduled event during which it was critical that she was not menstruating, she could take a pill that contained estrogen/progesterone on the days leading up to the event.

4. Name the labeled structures. [Various structures may be labeled]

- a) _____ b) _____
c) _____ d) _____



5. After class, you decide to for a run around Hilltop Circle. To do this, your muscles need more oxygen (among other things). Thinking of the respiratory and cardiovascular systems including how oxygen is transported, name as many things as you can that will change in your body so that your legs will get more oxygen than they did before you started to run.

Increased breathing rate

Increased breathing depth

Bronchodilation

Increased heart rate

Increased stroke volume via increased venous return and increased contractility

Vasodilation in leg muscle arterioles

Net vasoconstriction overall and in non-muscle tissues

Decreased pO₂ at leg muscles (hemoglobin saturation drops)

Increased pCO₂ at leg muscles (hemoglobin saturation drops)

Increased temperature in leg muscles (hemoglobin saturation drops)

Increased temp in body overall (increased speed of gas and nutrient diffusion)

Decreased pH/ increased H⁺ at muscle tissues (hemoglobin saturation drops)

[etc., other valid answers may be given; comparing the lists at the beginning and end of the semester is informative]

Action Potential Concept Quiz

Correct answers are bolded.

1. Which of the following causes repolarization of a neuron during an action potential—the “downswing” of the action potential?
 - a) Na^+ moving out of the cell
 - b) Na^+ moving into the cell
 - c) K^+ moving out of the cell**
 - d) K^+ moving into the cell
2. Which of the following would cause a hyperpolarized (farther away from zero) resting membrane potential?
 - a) more Na^+ outside the cell membrane
 - b) more Na^+ inside the cell membrane
 - c) more K^+ outside the cell membrane
 - d) more K^+ inside the cell membrane**
3. If you increased the amount of K^+ outside a cell membrane, how would that affect the action potential?
 - a) the peak would be higher
 - b) the peak would be lower
 - c) the repolarization would occur more slowly**
 - d) the repolarization would occur more quickly
4. Which of the following is the primary factor in preventing action potentials from “adding up”/piggybacking on each other?
 - a) the sodium-potassium pump begins running again after sodium channels have opened
 - b) voltage-gated sodium channels, once closed, stay closed for a specific period of time**
 - c) it takes time for positive charge to build back up to reach the threshold voltage for sodium channels
 - d) potassium leak channels are operating continuously throughout the action potential
5. The membrane potential, whether at rest or during an action potential, is dependent on (calculated using):
 - a) a combination of the Na^+ and K^+ equilibrium potentials, “weighted” by concentration gradients
 - b) ion concentration gradients as well as their permeability in the membrane**
 - c) the equilibrium potential of K^+ and its permeability, since it is the only ion that can affect the membrane potential
 - d) the rate of activity of the sodium-potassium pump, which has increased activity during action potentials

Cardiovascular Physiology Concept Quiz

Correct answers are bolded.

1. How is cardiac output calculated?

- a) (venous return + end-diastolic volume) x heart rate
- b) (heart rate x contractility) x (stroke volume x ejection fraction)
- c) heart rate x stroke volume**
- d) ejection fraction x (venous return/contractility)

2. During the T wave of the ECG, what is happening electrically in the heart?

- a) the atria are depolarizing
- b) the atria are repolarizing
- c) the ventricles are depolarizing**
- d) the ventricles are repolarizing

3. Which if the following would increase stroke volume?

- a) increased heart rate
- b) increased cardiac output
- c) increased venous return**
- d) increased acetylcholine release on the heart

4. Which of the following changes is likely to increase venous return?

- a) starting to exercise**
- b) increased parasympathetic activity
- c) decreased arterial blood pressure
- d) dehydration

5. In your post-class run around the loop, suppose the diameter of the artery carrying blood to your leg muscles increased to 3x its original diameter. How much more blood would flow through it than before?

- a) 3 times
- b) 9 times
- c) 27 times
- d) 81 times**

Immune Concept Quiz

Correct answers are bolded.

1. Which is a major function of natural killer cells?
 - a) phagocytosis of extracellular pathogens such as bacteria
 - b) release of histamines in response to the presence of invading pathogens
 - c) secreting antibodies to tag pathogens for destruction by granzymes or perforins
 - d) destruction of cancerous or virus-infected cells in the body**
2. What is the major action of interferons?
 - a) to stimulate blood flow to the affected area, increasing “delivery” of immune cells there
 - b) to block viral replication in neighboring body cells**
 - c) to inhibit the reproduction of bacteria by blocking steps in their cell cycle
 - d) to attract lymphocytes, neutrophils, and other leukocytes to pathogen-infected areas
3. Antigen-presenting cells will be most important in a:
 - a) bacterial infection
 - b) viral infection**
 - c) parasite infection
 - d) re-infection (secondary response) of either a bacterial or viral infection
4. Uriah is allergic to leaf mold. This is because there is a substance in leaf mold which:
 - a) is somewhat dangerous to Uriah
 - b) is somewhat dangerous to everyone, but Uriah’s body has detected the danger better than most
 - c) Uriah’s immune system responds to, but which is not actually dangerous**
 - d) Uriah’s immune system recognizes, but does not respond to
5. Wiley had the mumps when he was six, so even though he is an adult now, he is essentially unable to ever become ill from it again. Why not—what will happen if he is exposed to mumps?
 - a) it will be unable to enter his body
 - b) it will be destroyed by antibodies that have been continuously produced in his blood since his initial exposure
 - c) it will be destroyed by lymphocytes activated by memory cells’ recognition of this virus**
 - d) it will be destroyed directly by the memory lymphocytes which recognize the virus

