3600-Plus Review Questions for Anatomy & Physiology

Volume 2
(4th edition)

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This is the 4th edition of this work. The first two editions were released under the title, "1800+ Review Questions for Anatomy & Physiolody II."

Edition History for '1800+ Review Questions for Anatomy and Physiology II' (renamed from the 3rd edition onward to: "3600-Plus Review Questions for Anatomy & Physiology: Volume 2")

June 2006, R. Michael Anson: First edition.

The questions were written one topic at a time during the spring of 2006. Students in a class which I was teaching were given access to them, and their feedback used to guide minor revisions prior to the compilation of the questions into this document at the end of the course. I would be happy to receive feedback, positive or negative, or to learn of errors that may be present: my email address is anson@jhu.edu .

August 2007, R. Michael Anson: 2nd edition

Blood

Deleted: 15, 47, 60, 64, 81, 84, 96

Added: 15a, 47a, 60a, 64a, 81a, 84a

The Heart

Deleted: 19, 21, 26, 29, 103, 104, 138, 158

Added: 19a, 26a, 103a, 104a, 138a, 158a

Corrected several minor typographical errors which did not alter meaning.

Blood Vessels

Deleted: 160, 161, 164, 209, 216

Added: 209a, 216a

The Lymphatic System

Deleted: 21, 36

Added: 21a, 36a

Corrected several minor typographical errors which did not alter meaning.

The Immune System

Deleted: 37, 66

Added: 13a, 37a, 66a

The Respiratory System

Deleted: 41, 42, 65, 66, 108, 113

Added: 41a, 42a, 65a, 66a, 108a, 113a

Corrected several minor typographical errors which did not alter meaning.

Digestive System - Anatomy

Deleted: 78, 79

Added: 78a, 79a, 80

Digestive System - Physiology

Deleted: 22, 130, 141, 163

Added: 22a, 115a, 115b, 115c, 115d, 121a, 130a, 141a, 163a

Corrected several minor typographical errors which did not alter meaning.

Nutrition
Deleted: 69, 86, 87.
Added: 27a, 27b, 69a, 86a, 87a.

Metabolism
Deleted: 27, 29, 30, 31, 32, 37, 38, 46, 52
Added: 27a, 29a, 30a, 30b, 31a, 32a, 37a, 38a, 46a, 52a

The Urinary System
Deleted: 10, 40, 84, 113, 124, 132, 133, 139
Added: 10a, 40a, 84a, 113a, 124a, 132a, 133a, 139a

Fluids and Electrolytes
Deleted: 0
Added: 61a

The Male Reproductive System
Deleted: 34
Added: 34a

The Female Reproductive System
Deleted: 57
Added: 57a

Reproduction
Deleted: 51
Added: 51a

December 2008, R. Michael Anson: Third Edition

Changed title to “3600 + Review Questions for Anatomy and Physiology: Volume 2”

In addition to the correction of many minor typographical errors (capitalization errors, etc.), the following changes were made:

Changed the original numbers to “unique ID” codes (UIDs).

Purpose: UIDs are needed by teachers who wish to correlate test banks in various formats (fill in the blank, multiple choice, T/F, etc.) with the original question. Initially, the original question number was used as the UID, but these created reader confusion as deleted questions resulted in “missing” numbers, etc.

To generate UIDs, the first letter of each major word in the section was used as a prefix the original question number, and “a,” “b,” etc., used as a suffix when changes are necessary.

Questions numbers from this edition forward are arbitrary and refer only to the position of a particular question within the particular edition being used.

A table correlating the question number in a particular edition with the UIDs will be provided as an appendix.

Blood
Deleted: 15, 47, 64, 81, 84, 113, 116, 123
Added: B15a, B47a, B64a, B81a, B84a, B113a, B116, B123a

Heart
Deleted: 36, 112, 118, 126, 134

Added: H36a, H112a, H118a, H126a, H134

The Respiratory System
Deleted: 113a
Added: RS113b

The Urinary System
Deleted: 70, 124a, 164, 165
Added: US70a, US124b, US1641, US164b, US164c, US165a

The Female Reproductive System
Deleted: 34
Added: FRS34a

<u>January 2012, R. Michael Anson: Fourth Edition</u>

Note that minor changes in punctuation or wording which do not change the meaning of the question are not recorded here.

A “references” section was added in this edition. It would be a herculean task to add a reference to each question, but these were the general sources for the bulk of the material, and several sections now contain material not found in typical “A&P” texts..

Blood
  Deleted: B1, B31, B49, B55, B58, B61, B120
  Added: B1a, B31a, B49a, B55a, B61a, B120a

The Heart
  Deleted: H16, H23, H26, H39, H40, H41, H42, H43, H44, H45, H46, H47, H48, H50, H51, H89, H91, H95, H97, H98, H99, H177, H203
  Added: H16a, H23a, H26a, H39a, H39b, H39c, H40a, H41a, H42a, H42b, H42c, H42d, H43a, H43b, H44a, H45a, H46a, H47a, H48a, H50a, H50b, H50c, H52a, H52b, H52c, H52d, H52e, H52f, H52g, H52h, H52i, H52j,H52k, H89a, H91a, H97a, H98a, H99a, H177a, H203a, H203b

The Lymphatic System
  Deleted: LS43
  Added: LS21b, LS43a

The Immune System
  Deleted: IS3, IS10, IS23, IS48, IS51, IS57, IS67, IS71, IS90, IS91
  Added: IS3a, IS10a, IS13b, IS13c, IS23a, IS33a, IS34a, IS48a, IS51a, IS57a, IS67a, IS71a, IS90a, IS91a, IS92a

Blood Vessels
  Deleted: BV56, BV225
  Added: BV56a, BV56b, BV152a, BV225a

Respiratory System
  Deleted: RS11, RS12, RS15, RS166, RS169, RS171
  Added: RS11a, RS12a, RS15a, RS166a, RS169a, RS171a

Digestive System – Anatomy
Deleted: DSGA44', DSGA74
Added: DSGA44a, DSGA74a

Digestive System – Physiology
Deleted: DSP68, DSP131
Added: DSP68a, DSP131a

Nutrition
Deleted: N54, N74, N81, N84, N89, N90, N91
Added: N54a, N74a, N81a, N84a, N89a, N90a, N91a

Metabolism
Deleted: M7, M53
Added: M7a

The Female Reproductive System
Deleted: FRS18, FRS23,FRS25
Added: FRS9a, FRS10a, FRS10b, FRS10c, FRS15a, FRS15b, FRS15c, FRS15d, FRS18a, FRS23a, FRS25a

Reproduction
Added: R64a

The preamble below is taken from '1700+ Review Questions for Anatomy and Physiology I.' They are as relevant for Anatomy and Physiology II as for Anatomy and Physiology I, and so are included here.

A note to the student:

Memorization is easiest if questions are answered out loud and in writing. This means that it is a good idea to have a plentiful supply of scrap paper handy as you study! (As for the out loud aspect of study, well, in some situations - on a bus, for example - this may not be wise. Thinking an answer is better than not studying at all, of course!)

If you encounter a word you do not understand while studying this question bank, you should look it up! Memorizing random, meaningless sounds or letter combinations is much harder than memorizing words and concepts which you understand, and information you understand is retained longer! (You will find this especially important on cumulative exams.)

If a question (or an answer) involves something visual (for example: 'After studying hard for hours, sometimes my ____ hurts,' where the answer is 'head'), be sure that you can picture it in your imagination. Refer to textbooks, etc., if you cannot. In this way, by studying the review questions, you are at the same time studying for your laboratory exams. More importantly, you will gain a greater understanding of the material and this will help you to use it and to remember it on exams and in your future career.

While you study, don't try to swallow an entire topic in one huge gulp. The first step to learn new material by using this question bank is to read four or at most five questions. Once theseare familiar, but before the answers are well-known, hide the answers and try to fill in the blank for each question. Don't just do it in your head: write each answer down on scrap paper, and if you're alone, say it out loud. This simple trick can double or triple your learning speed!

Once you've mastered a set of four or five questions completely, don't simply rush to newer material: consolidate the older material by going back and reviewing the questions that came before the ones you just mastered. This will help it to move into long-term memory.

Once you have mastered the questions in a section in order, review them by answering every fifth one until you can answer them all in that way also. (The number five is arbitrary: the key is to review them out of order.)

Once you know an entire set, you will be surprised at how quickly you can review it. Don't put it aside completely: spend an hour or so each week reviewing topics you've already mastered, and midterms and finals will seem easy! (Ok, well, let's be accurate - ***easier***.)

Memorization is not the end of your learning process, it is the beginning. Once you have the facts, you must learn to use them! This is beyond the scope of this question bank, but is a fact you'll probably become familiar with during your lectures or laboratory sessions. Good luck with your studies!

R. Michael Anson
23-Nov-05

A note to my fellow educators:

The memorization of factual information and the application of information using critical thinking have in recent years come to be viewed by many educators as antithetical. This assumption has led to arguments against the teaching of factual knowledge at all, and those of us who suggest that students should commit factual information to memory, perhaps by using flashcards, are often treated to the sneers and jeers of our colleagues.

Nonetheless, it is my firm belief that a period of memorization prior to exercises in application accelarates the learning process dramatically. A student who has no prior knowledge in a field, when presented with a problem in critical thinking, is faced with several hours of flipping through the indices of various texts to find all of the facts which may be relevant and useful. While the material learned will be well-retained due to the effort expended, the use of time is inefficient at best. In contrast, a student who has been guided in the memorization of some basic factual information, when presented with the same problem, may flip through the mental indices in seconds or minutes, and the 'aha!' moment is the more dramatic and satisfying for its speed.

With that in mind, this collection of questions was prepared. The questions are essentially exercises in active reading. Once the students are sufficiently familiar with the topics, they will find that they can read the questions fairly quickly, rapidly replacing the blanks with the correct word or phrase. At that point, they have the facts at hand which will allow them to solve many problems with which they might be presented in anatomy and physiology. Should the serious student stop after memorizing the material, and never use it, never apply it to problems? Clearly not. It is hoped that this information will simply be the foundation on which a solid set of problem solving skills will be built.

R. Michael Anson
26-Aug-05

1. Blood is a specialized _____ tissue consisting of plasma-membrane-enclosed units, called _____, suspended in a nonliving fluid matrix called _____.	connective; formed elements; blood plasma
2. The normal pH of blood is between _____, and even a slight change away from this value causes severe health problems.	7.35–7.45
3. Although it varies with body weight, normal blood volume is approximately _____ liters. (A liter is a little over four _____, in the American system.)	5; cups
4. A major function of blood is the delivery of _____ and _____, which are needed for other tissues to live and grow.	oxygen; nutrients
5. A major function of blood is the removal of _____ produced by other tissues.	metabolic waste
6. A major function of blood is the distribution of _____, which control and coordinate the activity of the body.	hormones
7. By carrying _____ from the body's core to its surface, blood has a major role in the control of body temperature.	heat
8. By exchanging acids, bases, and hydrogen ions with other fluid compartments within the body and CO_2 with the air, blood plays a major role in the control of _____ throughout the body.	pH
9. A cut (usually) does not lead to a fatal loss of blood because blood is able to _____.	clot
10. Even though most wounds introduce hostile bacteria into the body, they are not fatal because the blood carries components of a very efficient defense system called the _____.	immune system
11. Blood plasma is 90% _____.	water
12. _____ consists of much more than just water in which blood cells float: it also contains nutrients, gases, hormones, wastes, products of cell activity, ions, and proteins.	Blood plasma
13. 60% of the protein found in blood plasma is of one class: _____. Albumin, and many other proteins, carry molecules which are not _____.	albumin; water soluble
14. There is so much _____ in the blood plasma that it is the major contributor to blood's osmotic pressure. In addition, the side chains of its amino acids can bind or release hydrogen ions, making it an important _____.	albumin; buffer
15. In addition to transport proteins, blood plasma also contains proteins such as _____, which are needed to protect the body from invaders, and proteins needed for blood _____ in case of injury.	antibodies; clotting
16. _____, _____, and _____ are the 'formed elements.'	Erythrocytes; leukocytes; thrombocytes (also called platelets)
17. The 'formed elements' in blood are not simply called 'cells' because two of the three types don't even have a(n) _____.	nucleus

18. _____, or red blood cells, are small cells that are biconcave in shape. They lack nuclei and most organelles. Their major function is to carry the oxygen-binding protein _____.	Erythrocytes; hemoglobin
19. _____ is an oxygen-binding _____ (light-absorbing chemical) that is responsible for the transport of most of the oxygen in the blood.	Hemoglobin; pigment
20. Hemoglobin derives its color from one of its parts: the molecule _____, which contains an atom of iron, is red. The rest of hemoglobin (the protein _____) is colorless.	heme; globin
21. Hemoglobin is well-known for its ability to carry oxygen from the lungs to the tissues of the body, but on the return trip, it also carries about 20% of the _____ from the tissues of the body to the lungs.	carbon dioxide
22. If erythrocytes had mitochondria, they would use _____ and would have less to deliver to tissues of the body. Instead, they rely on _____ for energy.	oxygen; glycolysis
23. Blood cell formation (_____) occurs in the _____.	hematopoiesis; red bone marrow
24. All blood cells are descended from a single type of stem cell called a(n) _____, or _____. These stem cells divide, and some of their daughter cells become committed to forming specific types of blood cells.	hematopoietic stem cell; hemocytoblast
25. _____ is the formation of erythrocytes.	Erythropoiesis
26. The formation of erythrocytes is controlled by the hormone _____, most of which is produced by the _____ in response to a low supply of oxygen.	erythropoietin; kidneys
27. After a hematopoietic stem cell's descendent becomes committed to forming red blood cells, it begins to divide rapidly and fills with _____, which will be needed to synthesize hemoglobin.	ribosomes
28. After a cell which is destined to become an erythrocyte has accumulated enough hemoglobin to function, it shuts down and ejects the _____. At this stage, it is a functional but immature erythrocyte and is called a(n) _____.	nucleus; reticulocyte
29. Immature (but functional) erythrocytes normally make up _____ to _____ of the erythrocytes in the blood. Higher or lower numbers indicate a problem with the rate of erythrocyte formation.	1%; 2%
30. If there are too few erythrocytes in one's blood, then _____.	tissues will not receive enough oxygen
31. There are roughly _____ erythrocytes in a microliter of blood, but only _____ leukocytes.	5000000; 5000 to 10000
32. An insufficient number of functional erythrocytes in the blood is a(n) _____.	anemia
33. Anemias may be due to an insufficient number of _____ (e.g., after a loss of blood), an insufficient number of _____ (e.g., when there is insufficient iron in the diet), or an abnormality in the _____ itself (e.g., as in sickle-cell anemia).	erythrocytes; hemoglobin molecules per erythrocyte; hemoglobin
34. If there are too many erythrocytes in one's blood, then the blood will be _____. Consequences include clotting, stroke, or heart failure.	too thick

35. An excess number of erythrocytes in the blood is a(n) _____.	polycythemia
36. Iron is required in the diet because it is needed to make _____ during erythropoiesis: however, too much iron is toxic.	heme
37. Deficiencies in vitamin B12, folic acid, or major deficiencies in protein or energy, will all lead to problems with _____ formation.	erythrocyte
38. Without nuclei or organelles, erythrocytes have no way to _____ damage.	repair
39. As erythrocytes become old and damaged, they tend to become trapped in the smallest capillaries of the _____, where they are destroyed by _____. (This also occurs to a lesser extent in the liver and in bone marrow.)	spleen; macrophages
40. When heme from old erythrocytes is broken down, the _____ is recycled by the body, while most of the remainder of the molecule is converted to a chemical called _____.	iron; bilirubin
41. Bilirubin is released into the blood, binds to _____, and then is transported to the liver where it is secreted into the intestine by the gallbladder, in _____.	albumin; bile
42. Bilirubin is yellow, and if heme breakdown is excessive or if its excretion is impaired, the result is _____, a visible yellowing of the skin, whites of the eyes, etc.	jaundice
43. In the intestine, bilirubin is converted to _____. Some of this is then converted further to stercobilin, a brown pigment which gives feces their color, while some is _____.	urobilinogen; reabsorbed into the blood
44. The _____ convert reabsorbed urobilinogen into urobilin, a yellow pigment which gives urine its color.	kidneys
45. The protein portion of hemoglobin, _____, is also broken down when it is recovered from old and damaged erythrocytes, and the amino acids are recycled.	globin
46. _____ (white blood cells) are the only formed elements that have a nucleus and organelles - that is, that are true cells.	Leukocytes
47. Leukocytes are blood cells and are also a part of the _____ system.	immune
48. There are two major classes of white blood cell: _____ and _____. They are named for the presence (or absence) of visible _____ (small grains) when the cells are stained with Wright's stain.	granulocytes; agranulocytes; granules
49. Roughly three quarters of all leukocytes are _____.	granulocytes
50. There are three types of granulocyte: _____, _____, and _____.	neutrophils; basophils; eosinophils
51. Roughly one quarter of all leukocytes are _____. While some of these are phagocytic, others are not.	agranulocytes

52. There are two types of agranulocyte: _____ and _____.	lymphocytes; monocytes
53. 90% of all leukocytes are _____ or _____: the remaining three types account for 10% or less of the total number of leukocytes.	neutrophils; lymphocytes
54. Neutrophils can be recognized by their nuclei, which generally have _____. These cells also take up both acidic and basic dyes, which results in a(n) _____ color.	three or more lobes; light purple
55. The most common type of leukocyte are _____.	neutrophils
56. The main function of neutrophils is to _____.	phagocytize (or kill or eat) bacteria
57. Neutrophils use reactive oxygen as weapons in a process called the _____.	respiratory burst
58. Eosinophils can be recognized by their nuclei, which is generally _____. They also contain granules and nuclei which bind eosin, a(n) _____ dye. (Eosin binding is not unique to eosinophils, though: red blood cells and muscle fibers, to name two of many others, are also stained by eosin.)	bi-lobed; red
59. Eosinophils are found in large numbers in the columnar epithelia of the _____, _____, and _____, where they guard against entry of foreign invaders into the body.	skin, lung, and GI tract
60. The two least common leukocytes in blood are the _____ and _____, which together account for less than 4% of all leukocytes.	basophils; eosinophils
61. Basophils can be recognized by their nuclei, which are _____ and _____. However, the nuclei are somewhat _____ by cytoplasmic granules, which bind to basic dyes and appear _____.	large; lobed; obscured; dark (or black)
62. Basophils release _____, which dilates blood vessels (and attracts other leukocytes) so that the immune system can reach and attack an invading organism.	histamine
63. The cytoplasmic structures of agranulocytes _____ and so are not visible.	do not stain with dyes
64. There are roughly 2250 _____ (which type of formed element?) in a microliter of blood. Most, however, are in _____ tissue rather than the blood.	lymphocytes; lymph
65. Lymphocytes can be recognized by their nuclei which are _____, and by their cytoplasm, of which there is _____.	round; very little
66. _____ are agranulocytes which directly attack viral-infected and tumor cells.	T lymphocytes
67. _____ are agranulocytes which differentiate into cells which produce antibodies.	B lymphocytes

68. Monocytes can be recognized by their size (they are very _____ compared to other blood cells), by the _____ shape of their nucleus, and by the _____ in their cytoplasm.	large; indented or U; absence of granules
69. _____ are agranulocytes which become _____ ('large eaters'), cells with two important functions: eating invaders and activating lymphocytes so that they too can defend the body.	Monocytes; macrophages
70. _____ is the formation of white blood cells.	Leukopoiesis
71. The formation of white blood cells is primarily controlled by hormones released by _____ and _____.	macrophages; T lymphocytes
72. The hormones which stimulate the formation of white blood cells fall into two families: _____ and _____. (Chemical signals that cause cells to divide are called _____.)	interleukins; colony-stimulating factors (CSF); cytokines
73. Most blood cells die within days or weeks, but monocytes may live for _____ and some lymphocytes live for _____.	months; years
74. _____ is an abnormally low white blood cell count.	Leukopenia
75. _____ refers to cancer in which an abnormal white blood cell fails to fully differentiate and begins to divide uncontrollably. Untreated, these cancers are always fatal.	Leukemia
76. There are roughly 275,000 _____ (which type of formed element?) in a microliter of blood.	platelets
77. Platelets are critical to the _____ process, forming the temporary seal when a blood vessel breaks.	clotting
78. Platelets are not complete cells, but fragments pinched off from large cells called _____.	megakaryocytes
79. Formation of the megakaryocytes involves repeated mitoses of megakaryoblasts without _____.	cytokinesis
80. Platelets are formed when a(n) _____ presses up against a specialized type of capillary in bone marrow, presses cytoplasmic extensions through the walls, and pinches them off.	megakaryocyte
81. _____ literally means 'blood stopping,' and is the formal name for the process which prevents blood loss after injury.	Hemostasis
82. _____ are the body's immediate response to blood vessel injury: this limits blood flow.	Vascular spasms
83. The second response of the body to a break in a blood vessel requires platelets, which _____.	form a plug
84. Platelets bind tightly to any _____ they happen to encounter. This molecule is normally not accessible, since it is in _____ but not epithelial tissue, not even endothelium.	collagen; connective

85. Platelets which have encountered collagen release _____ to attract other platelets, _____ to stimulate vasoconstriction, and _____ to help with both.	ADP; serotonin; thromboxane A_2
86. Platelets which have encountered _____ form _____ which allow them to reach out to, and adhere to, neighboring platelets.	collagen; cytoplasmic extensions
87. Platelet plugs at the site of an injury grow because of _____ feedback. To limit this to the site of the injury, undamaged epithelial cells release _____, which inhibits plug formation.	positive; PGI_2 or prostacyclin
88. After the platelet plug forms, the next step in the body's reaction to vascular injury is blood _____.	coagulation or clotting
89. Factors that promote clotting are called _____. Factors which inhibit clot formation are called _____.	clotting factors, or procoagulants; anticoagulants
90. Normal blood clotting requires thirteen major _____, which except for factor III (tissue factor) and factor IV (calcium ion) are commonly referred to by Roman numerals.	clotting factors, or procoagulants
91. Blood should only clot in response to injury: to prevent it from clotting inappropriately, _____ are also present in the blood plasma.	anticoagulants
92. Vitamin _____, which is made by bacteria in the gut, is needed for the formation of several _____ and so is essential if blood is to clot normally.	K; clotting factors, or procoagulants
93. Most procoagulants are present in the blood in a(n) _____ form.	inactive
94. The final, major steps in blood clotting are formation of _____, conversion of prothrombin to _____, and the formation of a(n) _____ mesh from fibrinogen in the plasma.	prothrombin activator; thrombin; fibrin
95. Prothrombin activator converts _____, which is an inactive enzyme, to _____, an active enzyme.	prothrombin; thrombin
96. The relatively small molecules of fibrinogen which are present in blood plasma are joined into long strands of _____ by _____, which together with calcium, also catalyzes the _____ of the strands.	fibrin; thrombin; crosslinking
97. Blood clotting may be initiated by either of two pathways: the _____ pathway is triggered by interactions between procoagulants and platelets, both of which are present in blood.	intrinsic
98. Blood clotting may be initiated by either of two pathways: the _____ pathway is triggered by _____ which is released by cells at the site of injury.	extrinsic; factor III or tissue factor or tissue thromboplastin
99. The _____ pathway initiates blood clotting quickly because it has fewer steps than the _____ pathway.	extrinsic; intrinsic
100. The components of plasma that remain after a clot forms are called _____. Clotting factors are for the most part absent, and _____ (released by platelets during clotting to stimulate cell division in injured tissue) are present.	serum; growth factors
101. Soon after the fibrin mesh forms, platelets begin pulling on it, squeezing the serum out of the clot. This process is called _____.	clot retraction

102. Blood clots contain a chemical called _____, which when activated by _____ is released from surrounding, healthy cells, gradually dissolves the clot.	plasminogen; tissue plasminogen activator
103. _____, when activated, forms plasmin: this enzyme dissolves unneeded clots in a process called _____.	Plasminogen; fibrinolysis
104. Three general mechanisms prevent unwanted clot formation and the spreading of a clot to areas where it is not needed: _____ of clotting factors by blood flow, _____ of clotting factors by anticoagulants, and entrapment of _____ by the fibrin mesh.	dilution; inhibition; thrombin
105. A blood clot that develops in an unbroken blood vessel is called a(n) _____. It may or may not become large enough to block the vessel, causing tissue hypoxia and possibly tissue death.	thrombus
106. A clot that breaks free of its original site and travels through the bloodstream is called a(n) _____: if it wedges itself into a vessel too small for it to traverse, clogging it, it is called a(n) _____.	embolus; embolism
107. Thromboembolytic disorders typically result from situations leading to _____ or _____.	roughening of vessel endothelium; impaired blood flow
108. _____ is a common, over-the-counter drug which inhibits thromboxane A2 formation and so interferes with blood clot formation (including those associated with thromboembolytic disorders).	Aspirin
109. _____ refer to the inability to form clots. _____ requiring clot formation occurs thousands of times each day during normal activity, and so such disorders are disabling or fatal.	Bleeding disorders; Microtrauma
110. A deficiency in circulating platelets ('_____'), failure of the liver to synthesize clotting factors, or a genetic defect in one or more of the clotting factors ('_____') all lead to bleeding disorders.	thrombocytopenia; hemophilia
111. Transfusion of _____ is now used only in the rarest of situations (e.g., when separated blood components are unavailable).	whole blood
112. Transfusion of _____ is more common when anemia is being treated, but blood volume in the patient is normal.	packed erythrocytes
113. If blood volume is dangerously low, there may not be time for transfusion of whole blood: _____, _____ (which pull liquid from tissue to blood via osmotic pressure), or _____ (which mimic the normal tonicity of blood) may be infused instead.	plasma; plasma expanders; electrolyte solutions
114. Humans have different _____ based on specific antigens on erythrocyte membranes. For several antigens, a severe immunoreaction occurs if a donor and a patient do not share the same one.	blood types
115. The _____ blood groups are based on the presence or absence of two types of antigens on the erythrocyte's surface.	ABO
116. In addition to the ABO antigens, some people also carry another antigen known as a(n) _____. Others do not carry it.	Rh factor
117. '_____' means 'glued together.'	Agglutinated
118. Antibodies present in a patient's blood act as _____ if blood of a mismatched type is transfused into a patient. (Each antibody can bind to _____ antigens, whether they are on the same cell or not.)	agglutinins; two or more

119. Clumping of erythrocytes due to an immune reaction (e.g. after an improper transfusion) causes _____ of small vessels and release of dangerous levels of _____ into the bloodstream.	blockage; hemoglobin
120. A fairly comprehensive picture of general health can be gained by two types of blood tests: _____ and _____.	blood chemistry profiles; complete blood count (CBC)
121. The _____ includes counts of the various formed elements, including platelets.	complete blood count (CBC)
122. The percentage of erythrocytes (by volume) is called the _____.	hematocrit
123. Blood that has been centrifuged separates into three layers: _____, _____ and _____.	erythrocytes; the buffy coat; plasma
124. The 'buffy coat' seen in centrifuged blood is composed of _____ and _____.	white blood cells; platelets
125. Leukocytes and platelets account for less than _____ of the blood's volume: the remainder is _____ (~ 55%) and _____ (~ 45%).	1%; plasma; erythrocytes
126. Fetal blood cells form hemoglobin-F, which has a higher affinity for oxygen than adult hemoglobin, hemoglobin-A, allowing _____. (Hemoglobin-F may hide defects in hemoglobin-A such as sickle cell anemia until several months after birth.)	fetal blood to accept oxygen from maternal blood

The Heart

1. The _____ of the heart is the widest part; the _____ is the narrow end, which points toward the left hip.	base; apex
2. The apex of the heart contacts the chest wall _____ <where?>: the heartbeat is most clearly felt here, and the site is called the _____.	just below the left nipple;point of maximal intensity (PMI)
3. The serous membrane which surrounds the heart is called the _____, the parietal layer of which lines the _____ in which it is enclosed. The visceral layer forms the outer surface of the heart's _____.	serous pericardium; fibrous pericardium; wall
4. The heart is found in _____ <which body cavity?> and two-thirds of it lies to the left of the midsternal line.	the mediastinum
5. The muscular wall of the heart (which accounts for most of the heart's mass) is called the _____.	myocardium
6. The heart wall is composed of _____ <how many?> blood-vessel-rich layers.	three
7. The central layer of the heart's wall is called the _____.	myocardium
8. The outermost layer of the heart wall, the _____, is actually the _____.	epicardium; visceral layer of the serous pericardium
9. The muscle fibers of the heart's wall are joined into ropelike structures arranged in circular bundles held together by the _____ of the heart.	fibrous skeleton
10. In addition to reinforcing the mechanical structure of the heart, the fibrous skeleton of the heart also acts as _____ to control the direction of action potential propagation.	electrical insulation
11. The inner lining of the heart and of blood vessels is a layer of squamous epithelium referred to as the _____.	endothelium
12. The two uppermost chambers of the heart are the _____.	atria
13. The two lowermost chambers of the heart are the _____.	ventricles
14. The partition that separates the left and right chambers of the heart is called the _____. The upper part is the _____, and the lower part is the _____.	septum; interatrial septum; interventricular septum
15. The septa which separate the chambers of the heart create indentations called _____ (the plural of _____) which are visible on the heart's surface.	sulci; sulcus
16. The shallow groove separating the atria from the ventricles is called the _____ or _____.	atrioventricular groove; coronary sulcus
17. The shallow grooves which mark the separation between the ventricles are the _____ (in the front) and the _____ (in the back).	anterior interventricular sulcus; posterior interventricular sulcus

18. The sulci of the heart serve as channels in which _____ lie.	blood vessels OR coronary arteries and veins
19. Inside, the _____ walls of the atria are smooth, while the _____ walls are ridged due to the presence of the comb-like strands of a muscle called the _____ muscle.	posterior; anterior; pectinate
20. In the fetal heart, there is an opening between the two atria called the foramen ovale. The shallow indentation in the interatrial septum which marks this location in the adult is the _____.	fossa ovalis
21. The purpose of the muscular wall of each _____ is simply to pump blood from one chamber to the next, and so not much muscle is required.	atrium
22. The right atrium receives blood from at least three veins: the superior and inferior _____ and the _____.	vena cavae; coronary sinus
23. The _____ returns blood from body regions above the diaphragm.	superior vena cava
24. The _____ returns blood from body regions below the diaphragm.	inferior vena cava
25. The _____ collects blood from the majority of the greater cardiac veins, and delivers it into the _____, near the fossa ovalis.	coronary sinus; right atrium
26. The _____ <which chamber of the heart?> receives blood that has just left the lungs.	left atrium
27. The word _____ refers to lungs, and so the veins entering the heart from the lungs are called the _____.	pulmonary; pulmonary veins
28. Most of the heart's volume is due to _____ <which two chambers>.	the ventricles
29. The word _____ means 'crossbar,' and has been seen before if one has studied bone.	trabecula
30. The inner walls of the ventricles of the heart are marked by ridges of muscle called _____, which means _____.	trabeculae carnae; crossbars of flesh
31. Nipple-shaped muscles called _____ project from the inner walls of the ventricle toward the atrioventricular valves, and prevent the valves from opening backwards during each heartbeat.	papillary muscles
32. The _____ <which chamber of the heart?> pumps blood to the lungs; the _____ <which chamber of the heart?> , to the body via a huge artery called the aorta.	right ventricle; left ventricle
33. The amount of force required to pump blood through the entire body is greater than the force needed to pump blood through the lungs or from atria to ventricles, and so the strongest muscles of the heart form the myocardium of the _____.	left ventricle
34. (True or False) In adults with normal blood flow, blood moves from one side of the heart to the other through openings in the septa.	FALSE

35. Beginning and ending in the right atrium, trace the flow of blood, naming each chamber of the heart, and mentioning the lungs and body. (Be able to do this no matter which point is chosen as the starting point.)	right atrium --> right ventricle --> lungs --> left atrium --> left ventricle --> body --> right atrium
36. Blood has to travel further in the _____ circuit than in the _____ circuit: therefore there is more friction, and more strength is required to keep it moving.	systemic; pulmonary
37. The _____ arteries, which supply the heart muscle itself with oxygen, arise <where?> _____.	coronary; at the base of the aorta
38. Coronary blood vessels often interconnect so that _____; these interconnections are called _____. (This is true of other blood vessels, too, but it is especially prevalent in the heart.)	more than one artery may supply each region of the heart; anastomoses
39. After passing through the capillary beds of the myocardium, venous blood is collected in the _____.	cardiac veins
40. The cardiac venous system may be divided into two major classes, greater and smaller. The smaller cardiac veins are usually _____ in diameter, and drain blood from the _____ myocardium.	less than 0.5 mm; inner
41. The cardiac venous system may be divided into two major classes, greater and smaller. The greater cardiac veins include vessels _____ in diameter, which drain the _____ myocardium.	greater than 1mm
42. There are usually <how many> _____ arteries leaving the aorta to provide supply the tissues of the heart. These are known as the _____.	two; main coronary arteries
43. The main coronary arteries are a good example of anatomical variability: in fact, in 4% of the population, _____ main coronary artery supplies the whole heart. (Other variations are possible.)	a single
44. The left coronary artery gives rise to which arteries?	left anterior descending artery; circumflex artery
45. The _____, which arises from the _____, supplies oxygen to the interventricular septum and anterior walls of both ventricles via septal and diagonal branches.	left anterior descending artery; left main coronary artery
46. The _____, which arises from the _____, supplies oxygen to the left atrium and (via one or more “left marginal branches”) parts of the left ventricle.	circumflex artery; left main coronary artery
47. In many (but not most) of the population, the circumflex artery continues until it reaches the interventricular septum, where it forms a(n) _____.	posterior descending artery
48. In almost half of the population, the SA node is supplied with blood by the _____.	circumflex artery
49. In most (but not all) people, the right coronary artery gives rise to which arteries?	acute marginal artery; posterior descending artery
50. The myocardium of the right lateral side of the heart is usually supplied by the _____ which arises from the _____.	acute marginal artery; right main coronary artery
51. The apex of the heart and the posterior ventricular walls are usually supplied by the _____ which arises from the _____.	posterior descending artery; right main coronary artery

52. The right atrium, AV node, and nearly all of the right ventricle are usually supplied by the _____.	right main coronary artery
53. In most of the population, the SA node is supplied with blood by a branch of the _____.	right main coronary artery
54. Most veins of the heart join together to form a large vessel called the _____, which is most visible on the _____ aspect of the heart.	coronary sinus; posterior
55. The narrow portion of the coronary sulcus, distal to the merging of the oblique vein of the left atrium (if present!), is the _____.	great cardiac vein
56. The four large veins that usually feed into the great cardiac vein and coronary sinus from the left side of the heart and septum are the _____, _____, _____ and _____ veins (distal to proximal).	anterior interventricular; left marginal; inferior left ventricular; middle cardiac
57. Not all blood returns to the heart via the coronary sinus: several of the cardiac veins return blood to the _____.	atria
58. The left or right main coronary arteries (LCA or RCA) are sometimes simply called the left (or right) _____.	coronary artery
59. The left anterior descending (LAD) artery is also known as the _____.	anterior interventricular artery
60. The acute marginal (AM) artery is also known as the _____.	right marginal artery
61. The posterior descending artery (PDA) is also known as the _____.	posterior interventricular artery
62. The right marginal vein is also sometimes referred to as if it were the distal portion of the _____	small cardiac vein
63. The small cardiac vein (or at least, the portion which lies in the coronary sulcus) is also known as the _____.	right coronary vein
64. The inferior left ventricular vein (which in some people is actually a cluster of smaller veins) is also known as the _____.	posterior left ventricular vein
65. The anterior interventricular vein is also sometimes referred to as if it were the distal portion of the _____	great cardiac vein
66. The left marginal vein is also known as the _____.	obtuse marginal vein
67. The middle cardiac vein is also known as the _____.	posterior interventricular vein
68. Damaged or dead myocardium is replaced by _____ (assuming the affected individual survives long enough to heal).	scar tissue

69. The _____ and _____ valves prevent backflow into the atria when the ventricles contract: together these are called the _____ valves.	tricuspid; bicuspid; atrioventricular (AV)
70. The _____ AV valve is the tricuspid valve.	right
71. The _____ AV valve is the bicuspid (or 'mitral') valve.	left
72. AV valves are one-way valves which allow blood to flow from the _____ to the _____. They are closed as the _____ contract.	atria; ventricles; ventricles
73. There are collagen cords called _____ anchoring the AV valves to muscular protrusions of the ventricular walls. These structures prevent the AV valves from being pushed open backwards by blood pressure.	chordae tendineae
74. In order to prevent the AV valves from being pushed open backwards by blood pressure, there are collagen cords anchoring them to _____, which are nipple-shaped muscles protruding from the ventricular walls.	papillary muscles
75. The AV valves are closed by the _____.	intraventricular pressure
76. The _____ and _____ valves prevent backflow of blood leaving the heart.	aortic semilunar SL; pulmonary semilunar
77. The two huge arteries leaving the heart are the _____ and the _____.	aorta; pulmonary artery
78. The pulmonary semilunar valve separates the _____ ventricle from the _____ artery.	right; pulmonary
79. The aortic semilunar valve separates the _____ ventricle from the _____.	left; aorta
80. The semilunar (SL) valves close due to _____.	backward pressure from blood in the vessels
81. The SL valves are _____ during contraction of the ventricles.	forced open
82. (True or False) There are no valves preventing backflow of blood from the heart into the veins which deliver blood to it from the body and lungs.	TRUE
83. (True or False) Atrial contraction nearly closes the openings through which blood enters the heart.	TRUE
84. If a valve in the heart malfunctions, and allows blood to flow in both directions, it is called a(n) _____.	incompetent valve
85. If one of the heart's valves becomes stiff or narrow, slowing blood flow, the condition is called _____.	valvular stenosis

86. Malfunctioning heart valves cause the heart to work harder, and the result is often _____.	cardiac failure
87. A cardiac muscle cell contains _____ <how many?> nuclei.	one to two
88. The space between groups of cardiac muscle cells is filled with _____, a(n) _____.	endomysium; loose connective tissue
89. The endomysium contains numerous _____ which serve the myocardium.	capillaries
90. Cardiac muscle fibers are arranged end to end to pull against each other, but the chains formed by these fibers ultimately pull against the _____ of the heart.	fibrous skeleton
91. Cardiac muscle fibers are joined end to end at a region called the _____, which contains two types of cell junction, _____ and _____.	intercalated disk; desmosomes; gap junctions
92. Desmosomes are present between adjoining cardiac muscle fibers to _____.	prevent the fibers from pulling apart when they contract
93. Gap junctions are present between adjoining cardiac muscle fibers to _____.	allow the fibers to contract as a single unit
94. Large numbers of _____ are necessary in cardiac muscle fibers to prevent fatigue.	mitochondria
95. Mitochondria account for _____ <what fraction> of a cardiac muscle fiber's volume.	1/4
96. Skeletal muscle, but not cardiac muscle, can depend on _____ for ATP generation.	glycolysis
97. (True or False) Cardiac muscle is capable of switching nutrient pathways to use whatever nutrient supply is available.	TRUE
98. The A, Z, and I bands are less distinct in cardiac muscle fibers than in skeletal muscle fibers because _____.	the myofibrils branch to go around mitochondria and so are not perfectly aligned
99. (True or False) The sarcomeres of cardiac muscle fibers have terminal cisternae at each end.	FALSE
100. As the frequency of stimulation to a skeletal muscle increases, the muscle reaches _____, a point of constant contraction. This does not happen in the heart because the _____ of each cell is quite long.	tetany (or tetanus); refractory periods
101. The three main processes leading to contraction of most cardiac muscle fiber are: _____ leading to a(n) _____ which is transmitted around the cell and down the T tubules, and _____.	influx of sodium; action potential; an increase in cytosolic calcium
102. Calcium enters the cytosol of cardiac muscle fibers from the _____ and the _____.	SR; extracellular space

103. Most cardiac muscle fibers have voltage sensitive ion channels in their sarcolemma that skeletal fibers do not: they are called _____ and admit _____ during an action potential.	slow calcium channels; calcium
104. Calcium, like sodium, is positive, and the special channels in most cardiac muscle fibers open and close _____: thus, calcium enters the cardiac muscle fiber _____, and the depolarization is _____.	slowly; slowly; long
105. The voltage sensitive potassium channels in cardiac muscle fibers are _____ than those in skeletal muscle fibers. This helps to _____ the action potential.	slower to open; prolong
106. The major function of motor nerve fibers innervating the heart is to _____.	modify heart rate
107. Autorhythmicity or automaticity refers to the ability of some cardiac muscle fibers to _____. Because _____ allow ions to pass into other cardiac muscle fibers, this triggers a(n) _____.	spontaneously depolarize; gap junctions; heartbeat
108. Autorhythmic cells are capable of _____.	spontaneous depolarization
109. The spontaneous depolarization of autorhythmic cells occurs because of a gradual increase in _____ caused by intentional _____ leakage.	membrane potential; sodium (or ion)
110. Unlike other cardiac myofibers, when the membrane potential of autorhythmic cells reaches threshold, the action potential is caused by rapid _____ entry through _____.	calcium; fast calcium channels
111. The rate at which autorhythmic cells spontaneously depolarize is controlled by the rate of _____.	ion leakage (or sodium leakage)
112. Because the autorhythmic cells are joined to one another by _____, a spontaneous depolarization of any of them causes depolarization of the rest.	gap junctions
113. The normal beating of the heart is initiated by the _____, a cluster of autorhythmic cells.	sinoatrial node (SA node)
114. Should the SA node for any reason fail, the _____ acts as an alternative initiator for the heartbeat.	atrioventricular node (AV node)
115. The cells of the _____ depolarize spontaneously roughly 75 times per minute.	sinoatrial node
116. Autorhythmic cells in the _____ depolarize about 50 times per minute in the absence of other signals.	AV node
117. The _____ is the cluster of autorhythmic cells in the heart which spontaneously depolarize the fastest and thus is known as the heart's _____.	SA node; pacemaker
118. In the absence of innervation or hormonal stimulation, the heart's rate is controlled by the _____. This rhythm is known as the _____ .	SA node; sinus rhythm
119. The connection between the SA node and AV node is known as the _____.	internodal pathway

120. The only electrical connection between the atria and the ventricles is provided by the _____, a collection of _____ cells. These are also called the _____.	atrioventricular bundle (AV bundle); autorhythmic; Bundle of His
121. The electrical signal in a normal heart travels from _____ through the _____ to the _____, then reaches the _____, travels down the _____ and around the _____.	SA node; internodal pathway; AV node; AV bundle; bundle branches; Purkinje fibers
122. The bundle branches are the autorhythmic cells which provide a pathway from the AV bundle through the _____ and to the Purkinje fibers.	interventricular septum
123. From the AV bundle to the apex, autorhythmic cells form _____ <how many?> pathways.	two
124. Purkinje fibers conduct the electrical signal around the _____ into the _____ walls.	apex; ventricular
125. The electrical impulse from the SA node to the _____ is rapid, but then it is slowed dramatically because the fibers there have fewer _____. This allows time for the _____ to contract before the _____.	AV node; gap junctions; atria; ventricles
126. Uncoordinated atrial and ventricular contractions are referred to as _____.	arrhythmias
127. When clusters of cardiac fibers contract independently, producing rapid and irregular or out-of-phase contractions, the condition is called _____.	fibrillation
128. Autorhythmic cells other than those in the SA node or AV node sometimes adapt a depolarization frequency more rapid than that of the SA node, producing a premature heartbeat. Cells acting in this way are referred to as a(n) _____.	ectopic focus
129. Caffeine and nicotine are two chemicals which can cause the temporary formation of _____, leading to irregular heartbeats.	ectopic foci
130. A premature contraction, especially of the ventricles, is technically described as a(n) _____, although it is more commonly referred to simply as a(n) _____.	extrasystole; PVC
131. Damage to the AV node which prevents electrical transmission is known as a(n) _____ because it electrically isolates the atria and ventricles.	heart block
132. The _____ is a cluster of neurons in the _____ whose function is to accelerate the heart rate.	cardioacceleratory center; medulla oblongata
133. The _____ is a cluster of neurons in the _____ whose function is to decelerate the heart rate.	cardioinhibitory center; medulla oblongata
134. The cardioacceleratory center is part of the _____ nervous system.	sympathetic
135. The cardioinhibitory center is part of the _____ nervous system.	parasympathetic
136. Neurons transmit signals from the cardioacceleratory center to the _____, _____, _____ and _____.	SA node, AV node, cardiac muscle, coronary arteries

137. Neurons transmit signals from the cardioinhibitory center to the _____ and _____.	SA node; AV node
138. Signals from the cardioinhibitory center are carried by the _____ nerve, whereas signals from the cardioacceleratory center travel through the _____ and _____ ganglia.	vagus; spinal cord; chain (or paravertebral)
139. A(n) _____ is a recording of all of the action potentials generated by both nodal and contractile cardiac fibers at any given instant.	electrocardiogram (ECG or EKG)
140. There are so many action potentials involved in a heartbeat that the action potentials are easily detected _____.	throughout the entire body
141. The exact size and shape of the various peaks on a normal ECG are determined by _____.	electrode placement
142. Whether an ECG signal is recorded as an inflection or deflection depends on the direction in which most action potentials are traveling relative to _____.	the electrodes
143. The _____ is the highest, strongest peak on a normal ECG together with the downward deflections that immediately precede and follow it.	QRS complex
144. The QRS complex is caused by spread of action potentials from the _____ of the heart all the way through the _____.	AV node; ventricles
145. The first inflection on a normal ECG, a small peak, is caused by depolarization in the fibers of the _____.	atria
146. The flat spot separating the first two peaks of a normal ECG is due to the _____ in action potential propogation imposed by the _____.	delay; AV bundle
147. After a brief delay, a third peak follows the first two. This third peak is called the _____ and is due to _____.	T wave; ventricular repolarization
148. The _____, _____ and _____ of the inflections and deflections on an ECG can all be used for diagnosis of heart ailments.	size; shape; timing
149. A(n) _____ on an ECG is occasionally not followed by a(n) _____; this indicates a heart block.	P wave; QRS complex
150. The first of the two heart sounds is due to the sudden rise in _____ when the _____ valves close.	ventricular pressure; AV
151. The second of the two heart sounds occurs when the _____ valves shut.	semilunar
152. The _____ valve can be heard by placing a stethoscope approximately midway between the right nipple and the right sternoclavicular joint.	aortic semilunar
153. The _____ valve can be heard by placing a stethoscope approximately midway between the left nipple and the left sternoclavicular joint.	pulmonary semilunar

154. The sound of the _____ valve can be heard by placing a stethoscope over the heart's apex, which is at the fifth intercostal space, directly inferior to the center of the left clavicle.	mitral (or bicuspid or left AV)
155. Sounds of the _____ valve can be heard by placing a stethoscope directly below the right sternoclavicular joint at the sternal margin of the fifth intercostal space.	tricuspid (or right AV)
156. _____, which are heard as a swishing sound over the heart, in adults indicate a problem. (In contrast, in _____, they may be normal sounds because the walls of the heart are somewhat thin.)	Heart murmurs; very young children and the elderly
157. _____ refers to the time during which a chamber of the heart is contracting, while _____ refers to the period of relaxation.	Systole; diastole
158. The term for the contraction of the atria is _____, and for the ventricles, _____.	atrial systole; ventricular systole
159. The term for the relaxation of the atria is _____, and for the ventricles, _____.	atrial diastole; ventricular diastole
160. About _____% of ventricular filling occurs passively: only the remainder is due to _____.	70; contraction of the atria
161. The volume of blood contained by the ventricles at the end of an atrial contraction is known as the _____. This term is based on the contents of the _____.	end diastolic volume (EDV); ventricles
162. At the beginning of a ventricular contraction, all of the valves are closed. The valves don't open until _____.	blood pressure in the ventricles exceeds that in the arteries
163. During ventricular contraction, the period during which all valves are closed is the _____.	isovolumetric contraction phase
164. The peak pressure in the ventricles occurs after _____, and reaches 120 mm Hg. This phase is called the _____.	the SL valves open; ventricular ejection phase
165. During ventricular systole, the atria are in _____.	diastole
166. The _____ is the period during which both the atria and ventricles relax.	quiescent period
167. Ventricular pressure is at its lowest just after the _____ valves open.	AV
168. Ventricular pressure begins to rise when the _____ valves close.	AV
169. Ventricular pressure peaks and begins to fall while the _____ valves are open.	SL
170. Ventricular pressure falls dramatically when the _____ valves shut and the ventricular contraction ends.	SL

171. Pressure in the aorta jumps briefly just after the _____ valve closes. This sudden change in pressure is called the _____. After that it falls steadily until the _____ valve reopens.	aortic SL; dicrotic notch; aortic SL
172. While the aortic SL valve is open, blood pressure in the _____ rises, then falls, as the ventricle empties.	aorta
173. Pressure changes in the heart's right chambers and in the pulmonary artery are similar to those in the heart's left chambers and in the aorta, with one difference: pressure is _____ on the right side than on the left.	lower
174. _____ is the volume of blood remaining in the ventricle when the SL valves close at the end of ventricular systole.	Ending systolic volume (ESV)
175. _____ pressure is relatively constant: it increases briefly during _____, and then again just after the _____ valves close.	Aatrial; atrial systole; AV
176. The change in the rate at which the ventricles are filling which occurs just before EDV is reached is due to _____.	atrial systole
177. Cardiac output is the amount of blood pumped by _____ in each _____.	each ventricle; minute
178. Stroke volume is the amount of blood pumped by _____ in each _____.	each ventricle; heartbeat
179. _____ is the difference between resting and maximal cardiac output.	Cardiac reserve
180. The formula relating cardiac output, stroke volume and heart rate is _____. (Note: be able to use it!)	CO = HR x SV
181. An average adult's stroke volume is _____.	70 ml / beat
182. The formula relating stroke volume, ending diastolic volume and ending systolic volume is _____. (Note: be able to use it!)	SV = EDV - ESV
183. _____ is the degree to which the heart muscle is stretched prior to a contraction.	Preload
184. The Frank-Starling law of the heart states that the critical factor influencing stroke volume is the _____.	preload
185. The overlap of myofilaments in resting skeletal muscle is optimized to maximize tension, but in cardiac muscle the _____.	overlap is greater
186. The amount that cardiac muscle is stretched prior to a contraction is generally related directly to the _____ during _____.	amount of blood entering; diastole
187. A slow heart rate _____ preload because _____.	increases; there is more time for blood to fill the heart

188. Because muscle contractions squeeze veins and accelerate the blood's return to the heart, they _____ preload.	increase
189. The strength of a heartbeat (which is known as the heart's _____) is in part controlled by the amount of _____ entering the cytoplasm with each contraction.	contractility; calcium
190. Sympathetic stimulation to the heart increases _____ by increasing _____ entry with each action potential.	contractility; calcium
191. _____ are factors, including many drugs, which increase the contractility of the heart.	Positive inotropic agents
192. _____ are factors, including many drugs, which decrease the contractility of the heart.	Negative inotropic agents
193. Agents which inhibit calcium's entry into cardiac myofibers will _____ contractility.	decrease
194. If membrane potential moves toward 0 because of changes in ionic concentration on one side, contractility will _____.	decrease
195. _____ are factors which increase heart rate.	Positive chronotropic factors
196. _____ is a heart rate of more than 100 beats per minute.	Tachycardia
197. _____ are factors which decrease heart rate.	Negative chronotropic factors
198. _____ is a heart rate of less than 60 beats per minute. In athletic individuals, this is normal due to the greater _____ in an athlete's heart.	Bradycardia; stroke volume (SV)
199. The sympathetic nervous system controls the heart by releasing _____ at cardiac synapses; this binds to _____ in the sarcolemma.	norepinephrine; beta-1 adrenergic receptors
200. Norepinephrine has several effects in the heart, including the _____ of slow calcium channels.	activation
201. Norepinephrine has several effects in the heart, including the _____ of SR proteins that trigger calcium release.	activation
202. Norepinephrine has several effects in the heart, including the _____ of myosin to increase the rate of crossbridge cycling.	activation
203. Norepinephrine has several effects in the heart, including the _____ of SR proteins that promote calcium reuptake, _____ the length of the refractory period.	activation; decreasing
204. Beta-1 adrenergic receptors in the heart, which are activated by the binding of _____, act through _____. These in turn activate _____ which phosphorylate many cellular proteins.	norepinephrine; G-proteins; protein kinases

205. If heart rate is increased, but contractility is not, there is a decrease in _____. (Understand why this is true so that other relationships can also be predicted. Example: if heart rate is decreased .... OR if contractility is increased ... etc.)	SV
206. The _____ is a sympathetic reflex which accelerates heart rate in response to an increased venous return to the atria.	Bainbridge reflex (a..k.a. atrial reflex)
207. Because exercise stimulates the heart through the _____, both heart rate and contractility are increased.	sympathetic nervous system
208. The parasympathetic system, which controls heart rate through the _____ nerve, interacts only with the _____ and so cannot alter contractility.	vagus; SA and AV nodes
209. The parasympathetic nervous system influences heart rate by releasing the neurotransmitter _____ which causes _____ to open. This leads to _____ of the cells in the SA and AV nodes.	acetylcholine; potassium channels; hyperpolarization
210. _____ refers to the fact that the heart generally beats slower than 75 beats per minute due to stimulation by the _____.	Vagal tone; parasympathetic nervous system
211. If an excitable cell is hyperpolarized, it is unable to reach _____ and so action potentials do not occur.	threshold
212. Epinephrine, which is released by the _____, mimics the effects of _____ and _____ the heart rate.	adrenal glands; norepinephrine; increases
213. Thyroxine (from the thyroid gland) causes the heart rate to _____.	gradually increase
214. _____ is chest pain caused by a brief decrease (without permanent cell injury) in blood delivery to the myocardium.	Angina pectoris
215. In a(n) _____, there is prolonged blockage of a coronary artery that leads to cell death.	myocardial infarction
216. _____ refers to a condition in which the pumping efficiency of the heart is too low to supply the body's needs.	Congestive heart failure (CHF)
217. _____ is the hardening or thickening or artery walls, reducing their ability to respond to changes in blood pressure and potentially limiting blood flow.	Arteriosclerosis
218. _____ is the clogging of blood vessels by fatty deposits, reducing their ability to respond to changes in blood pressure and potentially limiting blood flow.	Atherosclerosis
219. High blood pressure (_____) reduces the ability of the ventricles to _____ and _____ volume is increased.	hypertension; eject blood; ending systolic
220. _____ results in an increased back-pressure as the heart tries to pump blood through the body, and ultimately leads to _____ due to cardiac overwork.	Persistent hypertension; congestive heart failure (CHF)
221. A series of small myocardial infarctions (heart attacks) cause _____ because too much of the heart's mass is replaced by _____.	congestive heart failure (CHF); connective (or scar) tissue

222. _____ refers to a condition in which the ventricular myocardium weakens and stretches.	Dilated cardiomyopathy (DCM)
223. If the left side of the heart fails but the right side continues to pump normally, the blood pools in the _____, a condition known as _____.	lungs; pulmonary congestion
224. If the right side of the heart fails but the left side continues to pump normally, the blood pools in the _____, a condition known as _____.	extremeties; peripheral congestion
225. Although in the short term, one side of the heart can fail, the strain on the unaffected side ultimately causes _____.	both sides to fail
226. With few exceptions, most of the heart's development is complete within the first _____ months post-conception.	two
227. During fetal development, the two atria are connected by the _____ in order to allow blood to bypass the incomplete pulmonary circuit.	foramen ovale
228. During fetal development, there is a connection called the _____ between the pulmonary trunk (the base of the pulmonary artery) and the aorta. In the adult, all that remains of this is the _____.	ductus arteriosus; ligamentum arteriosum
229. Developmental defects of the heart, taken as a group, are the _____.	most common birth defects
230. Although aging does lead to changes in the heart, the general consensus is that _____ and _____ are the major contributors to cardiovascular disease.	inappropriate diet; inactivity

Blood Vessels

1. _____ carry blood away from the heart.	Arteries
2. _____ carry blood toward the heart.	Veins
3. _____ are the smallest blood vessels, through the walls of which gases and nutrients are exchanged with tissues.	Capillaries
4. _____ are the walls of blood vessels, while _____ is the central space through which blood flows.	Tunics; the lumen
5. The innermost wall of the blood vessels is called the _____ or _____.	tunica interna; tunica intima
6. The tunica intima consists of <which tissue type> _____, which is surrounded, in larger vessels, by a thin layer of connective tissue.	simple squamous epithelium (OR endothelium)
7. _____ is the middle tunic of blood vessels, and primarily consists of a mixture of _____ and _____.	Tunica media; smooth muscle; elastin
8. The _____ (also called _____) refers to the outermost layer of the blood vessel wall.	tunica externa; tunica adventitia
9. Larger blood vessels are anchored to the surrounding tissue by their outermost layer, which is composed mostly of _____.	loosely woven collagen fibers
10. In larger vessels, the outermost layer is too far from the blood it carries to exchange gases or chemicals, and so they have their own blood supply: the _____.	vasa vasorum
11. Nerve fibers, lymphatic vessels, and in large veins, elastin fibers are found in the _____ of the blood vessels.	tunica externa OR tunica adventitia
12. Arteries are classified into three types: _____, _____ and _____.	elastic artery; muscular artery; arteriole
13. Veins are classified into two types: _____ and _____.	venule; vein
14. _____ connect arterioles to venules.	Capillaries
15. _____ arteries are the thick-walled arteries nearest the heart, and function as shock-absorbers to minimize the difference between _____ and _____ blood pressure.	Elastic; systolic; diastolic
16. Elastic arteries are sometimes referred to as _____.	conducting arteries
17. Muscular arteries have more _____ and less _____ than elastic arteries.	smooth muscle; elastic tissue

18. The purpose of muscular arteries is to _____.	distribute blood
19. Another name for muscular arteries is _____.	distributing arteries
20. _____, also called _____, are the smallest arteries.	Arterioles; resistance vessels
21. _____ refers to the narrowing of the lumen of blood vessels due to contraction of smooth muscles in the blood vessel walls, while _____ refers to the widening of the lumen due to their relaxation.	Vasoconstriction; vasodilation
22. Capillaries are so small that in some cases a(n) _____ spans the entire circumference of the capillary wall, and RBCs must _____ to travel through.	single cell; deform slightly
23. In general, nutrient and waste exchange and gas exchange occurs by _____, but there are exceptions.	diffusion across capillary walls
24. (True or False) Cartilage and epithelia receive their nutrients from an extensive capillary bed.	FALSE: cartilage and epithelia have no capillaries.
25. The avascular cornea and lens of the eye receive nutrients and exchange gases with the _____.	aqueous humor
26. _____ capillaries are abundant in the skin and muscle.	Continuous
27. _____ capillaries are the most common.	Continuous
28. Endothelial cells in _____ capillaries are joined together by tight junctions, and are separated only by rare gaps called _____ which allow fluid and very small solutes to pass.	continuous; intercellular clefts
29. Continuous capillaries in the brain are unique in that they lack _____. As a result, even fluids and very small solutes _____.	intercellular clefts; cannot cross the capillary wall
30. Capillaries which contain oval pores called _____ through which fluids and solutes pass with ease are called _____.	fenestrations; fenestrated capillaries
31. _____ capillaries are found in the small intestine and are needed to absorb _____.	Fenestrated; nutrients from digested foods
32. _____ capillaries are present in the kidneys to allow filtration of blood plasma.	Fenestrated
33. _____ are extremely leaky capillaries through which even blood cells may sometimes pass. (They are often simply referred to as _____.)	Sinusoidal capillaries; sinusoids
34. In the liver, some capillaries have walls which are partially formed by large macrophages called _____. These capillaries are a type of _____.	Kupffer cells; sinusoid

35. The blood vessel that is structurally intermediate to an arteriole and a capillary is called a(n) _____.	metarteriole
36. From the point at which a capillary branches off from a metarteriole until it reaches the venule, the blood vessel conducting blood from the arteriole to the venule even when the capillary bed is not in use is called a(n) _____.	thoroughfare channel
37. Whether or not blood can leave a thoroughfare channel and enter the capillaries which make up the _____ depends on whether or not the _____ are open.	capillary bed; precapillary sphincters
38. Precapillary sphincters are made of _____.	smooth muscle
39. The smallest venules are the _____ venules.	post-capillary
40. Veins, especially those of the limbs, include _____ to prevent blood from flowing backwards.	valves
41. Varicose veins are veins which distend due to damage to their _____.	valves
42. Much of the structural integrity of veins is maintained by _____, which is why the valves of surface veins are more often damaged than those of deep veins.	surrounding tissue
43. _____ are low pressure channels which are not, structurally, typical veins, into which venous blood drains prior to entering true veins.	Venous sinuses
44. _____ are interconnections between blood vessels which allow blood to have multiple paths of flow.	Anastomoses
45. _____ anastomoses are more common than _____ ones.	Venous; arterial
46. _____ is the volume of blood flowing through a region in any given minute.	Blood flow (F)
47. Since the heart supplies the entire body, blood flow to the entire body is simply another phrase to describe _____, and resistance refers to _____ or _____ resistance.	cardiac output; systemic; peripheral
48. _____ is measured by determining the amount of pressure that must be applied in order to prevent blood flow.	Blood pressure (P)
49. Unless otherwise noted, the term 'blood pressure' refers to the blood pressure in the _____.	largest arteries near the heart
50. _____ is the amount of friction blood encounters as it moves through the body.	Resistance (R)
51. The three sources of resistance are _____, _____ and _____.	blood viscosity; vessel length; vessel diameter

52. The thicker a liquid is, the more _____ it is: for example, honey is more _____ than water. When moving through a tube, thick liquids generate more _____.	viscous; viscous; friction or resistance
53. Since the resistance to blood flow is a function of _____, gaining weight increases resistance.	the distance that the blood must travel
54. Changes in blood pressure due to environmental shifts are controlled by altering the _____.	blood vessel diameter
55. The relationship between vessel diameter and resistance to blood flow varies as a function of _____. (Note: be able to use this formula, and be able to interpret the answer as to whether blood pressure went up or down.)	1/ r4 where r is the radius
56. Blood flow, pressure, and resistance are related by the formula: _____. (Note: be able to use the formula!)	F = (change in pressure)/R
57. Combining the effects of viscosity, radius, pressure, vessel length, and resistance on blood flow gives a relationship known as _____.	Poiseuille's Law
58. The relationship between cardiac output, blood flow through the entire body, pressure, and resistance is given by the formula: _____. (Note: be able to use the formula!)	CO = F = (change in pressure)/ R
59. The change in pressure between two points in the circulatory system is determined simply by _____.	subtracting the lower pressure from the higher one
60. Blood leaving the heart causes the nearby arteries to _____. As the heart enters diastole, the nearby arteries _____ due to their _____.	stretch; recoil; elasticity
61. The reason blood keeps flowing even during ventricular diastole is that _____.	the distended arteries recoil, forcing blood forward
62. The blood pressure during the contraction of the ventricles is the _____ pressure, and is normally _____ in a healthy adult.	systolic; 120 mm Hg
63. The blood pressure during the relaxation of the ventricles is the _____ pressure, and is normally _____ in a healthy adult.	diastolic; 70 - 80 mm Hg
64. The _____ pressure is the difference between systolic and diastolic pressures. (Note: if given any two of these pressures, be able to calculate the third.)	pulse
65. _____ is chronically increased by arteriosclerosis because the arteries do not distend during ventricular systole, and thus store no energy to propel the blood during _____.	Pulse pressure; ventricular diastole
66. The _____ is the average pressure that propels the blood through the tissue.	mean arterial pressure; MAP
67. The relationship between systolic, diastolic, and mean arterial pressures is _____. (Note: be able to use this formula. You may be required to combine two calculations, for example, pulse pressure may not be explicitly given.)	MAP = diastolic pressure + pulse pressure/3
68. Blood pressure in capillaries is _____, because although each capillary is small, the cross sectional area through all capillaries as a group is _____.	low; large

69. Two factors besides the blood pressure generated by the heart promote return of the blood to the heart: _____ and _____. Both of these _____, pushing blood through the one-way valves and moving it toward the heart.	respiration; muscular contraction; squeeze the veins
70. The effects of respiration and muscular contraction on the heart are referred to as the _____ and _____, respectively.	respiratory pump; muscular pump
71. If the blood volume were 0, the blood pressure would be _____. As blood volume increases, _____.	zero; so does blood pressure
72. Short-term, rapid compensation is mediated _____.	neurally
73. Neural controls of peripheral blood flow have two major effects: by altering _____, they control (1) the ultimate _____ of the blood, and (2) the _____ at which it is delivered.	vessel diameter; destination; rate and pressure
74. The central control of blood pressure and flow is the _____ in the _____.	cardiovascular center; medulla oblongata
75. The cardiovascular center has three centers: the _____, which controls blood vessel diameter, the _____, which accelerates the heart and increases contractility, and the _____, which decelerates the heart.	vasomotor center; cardioacceleratory center; cardioinhibitory center
76. Stimulation by the vasomotor center causes vasoconstriction of both _____ and _____.	arteries; veins
77. Arterioles are almost always somewhat constricted. This condition is called _____.	vasomotor tone
78. Control of artery and arteriole diameter is transmitted from the vasomotor center to the arteries and arterioles by _____ fibers which exit the CNS in the _____ and _____ regions.	vasomotor; thoracic; upper lumbar
79. The vasomotor system is part of the _____ nervous system, and thus its neurotransmitter is primarily _____ and the response is _____.	sympathetic; norepinephrine; vasoconstriction
80. The cardiovascular center receives input from three sources: _____, which sense blood pressure; _____, which sense oxygen, carbon dioxide, and pH; and _____, which conveys information regarding stress, temperature, and other indirect factors.	baroreceptors; chemoreceptors; higher brain regions
81. One group of _____, which sense blood pressure, are located in the _____, which are slightly wider regions of the internal carotid arteries.	baroreceptors; carotid sinuses
82. The cluster of baroreceptors near the heart is located in the _____.	aortic arch
83. Signals from the baroreceptors indicating that blood pressure is high result in three events: the _____ and _____ centers become less active, and the _____ center becomes more active.	vasomotor; cardioacceleratory; cardioinhibitory
84. Signals from the baroreceptors indicating that blood pressure is low result in three events: the _____ and _____ centers become more active, and the _____ center becomes less active.	vasomotor; cardioacceleratory; cardioinhibitory
85. The baroreceptors in the carotid sinus participate in the _____ reflex, and function to protect the _____.	carotid sinus; blood supply to the brain

86. The baroreceptors in the aortic arch participate in the _____ reflex, and function to maintain _____.	aortic arch; blood pressure in the systemic circuit
87. When blood pH decreases, carbon dioxide exhalation must be _____ to help return the pH to its normal value. This requires that heart rate, blood pressure and breathing rate _____.	increased; increase
88. When blood pH increases, carbon dioxide exhalation must be _____ to help return the pH to its normal value. This requires that heart rate, blood pressure and breathing rate _____.	decreased; decrease
89. Changes in blood pH are sensed by _____ in the _____, _____, and _____.	chemoreceptors; medulla oblongata; carotid arteries; aorta
90. When blood carbon dioxide increases beyond acceptable levels, carbon dioxide exhalation must be _____. This requires that heart rate, blood pressure and breathing rate _____.	increased; increase
91. Changes in blood carbon dioxide levels are sensed by _____ in the _____, _____, and _____.	chemoreceptors; medulla oblongata; carotid arteries; aorta
92. When blood oxygen falls to dangerous levels, oxygen inhalation must be _____. This requires that heart rate, blood pressure and breathing rate _____.	increased; increase
93. Changes in blood oxygen levels are sensed by _____ in the _____ and _____.	chemoreceptors; carotid arteries; aorta
94. Blood pressure and heart rate are modified due to information from chemoreceptors in response to _____ changes in blood chemistry, and so are generally unused except in emergencies.	dramatic
95. _____ is released by the medulla of the adrenal glands in response to exercise or stress. This hormone mimics the effects of _____, and _____ blood pressure and heart rate.	Epinephrine (or adrenaline); norepinephrine; increases
96. Arterioles and veins have two types of _____ receptors which bind epinephrine. This allows one chemical to have two effects depending on its concentration and location.	adrenergic
97. Long-lasting, slow compensation to adjust blood pressure is primarily controlled by the _____.	kidneys
98. The direct renal mechanism alters _____.	blood volume
99. The indirect renal mechanism, also known as the _____ mechanism, triggers a series of reactions that produce the potent vasoconstrictor _____.	renin-angiotensin-aldosterone; angiotensin II
100. When blood pressure in the kidneys is insufficient, they release _____. This in turn leads to the production of _____, and this in turn stimulates _____ and also production of _____.	renin; angiotensin II; vasoconstriction; aldosterone
101. Aldosterone, released by the cortex of the _____, _____ blood pressure by causing _____ and thus _____.	adrenal glands; increases; salt retention; water retention
102. ADH (_____; it is also known as _____) is released by the _____ in response to decreased blood pressure and increased blood osmolality.	antidiuretic hormone; vasopressin; pituitary

103. ADH has two effects on blood pressure. At low levels, it has a direct effect by increasing _____. At higher levels, it has an indirect effect by causing _____.	blood volume (or water retention): vasoconstriction
104. ANP (_____) is released by the _____ in response to increased pressure.	atrial natriuretic peptide; atria of the heart
105. ANP decreases blood pressure by promoting _____; this also causes _____.	sodium excretion; water excretion
106. Nitric oxide acts to _____.	dilate blood vessels.
107. Inflammatory chemicals act as _____.	vasodilators
108. Alcohol inhibits _____, thereby indirectly decreasing _____.	ADH; blood volume
109. The pulse can be felt above the shoulders at the _____, _____ and _____.	common carotid artery; facial artery; temporal artery
110. The pulse in the temporal artery can be felt _____.	just above the zygomatic arch
111. The pulse due to the common carotid artery can be felt _____ muscle, at the vertical midline of the _____.	just anterior to the sternocleidomastoid; neck
112. The pulse in the facial artery can sometimes be felt _____.	centrally on the lateral aspect of the mandible.
113. The pulse can sometimes be felt _____ due to the axillary artery.	under the arm
114. In the arm, the pulse can sometimes be felt _____ due to the brachial artery.	in the antecubital region
115. In the arm, the pulse can be felt _____ due to the radial artery.	on the anterior of the wrist
116. Below the waist, the pulse can sometimes be felt _____ due to the femoral artery.	in the groin
117. Below the waist, the pulse sometimes can be felt _____ due to the popliteal artery.	at the back of the bent knee
118. Below the waist, the pulse can sometimes be felt _____, due to the posterior tibial artery.	in the ankle, posterior to the medial malleolus
119. Below the waist, the pulse can be felt at the _____ due to the dorsalis pedis artery.	front of the ankle

120. In addition to their utility in determining heart rate, pulse points are also _____ which allow blood flow to the region they serve to be stopped in the event of injury.	pressure points
121. Blood pressure is measured by using a(n) _____.	sphygmomanometer
122. _____ means 'listening to the bodily sounds.'	Auscultation
123. Sounds heard through the stethoscope after a period of silence during a blood pressure determination are due to the _____. This is the _____ pressure.	blood spurting into the constricted artery; systolic
124. As the heartbeat forces blood past the blood pressure cuff and into the constricted arteries, the sounds that are heard using a stethoscope are called the _____.	sounds of Korotkoff
125. During a blood pressure determination, the point at which sounds of blood flow can no longer be heard during the release of pressure from the cuff corresponds to the _____.	diastolic pressure
126. _____ is a sudden drop in blood pressure due to a change in posture to an erect position.	Orthostatic hypotension
127. Nutritional deficits or diseases which cause a decrease in blood viscosity cause _____.	chronic hypotension
128. Blood loss causes blood pressure to _____.	drop or decrease
129. Blood pressure is in the 'hypertensive' range when it is _____ or greater.	140/90 mm Hg
130. _____, the most common type, is a chronic elevation in blood pressure with no apparent cause.	Essential hypertension (or primary hypertension)
131. _____ refers to the ability of many organs to change blood pressure within the organ itself via modification of arterial diameter.	Autoregulation
132. Changes in blood flow to an organ induced by the need for additional oxygen or nutrients (or to remove wastes) are known as _____.	metabolic controls
133. Changes in blood flow to an organ induced by stretching or constriction of the blood vessels supplying the tissue are known as _____.	myogenic controls
134. When the blood supply to a tissue is restored after a period of ischemia, it is _____. This effect is termed _____.	higher than normal; reactive hyperemia
135. If the oxygen or nutrient requirements of a tissue are higher than the supply, the long-term response of the body is _____ (that is, _____).	angiogenesis; creation of new blood vessels
136. _____ within the brain is so finely tuned that individual neurons, when active, receive more blood than those that are inactive.	Autoregulation

137. Of all the organs in the body, autoregulation of the blood supply to the _____ is most stringent and controlled.	brain
138. A major function of the blood vessels within the skin is to allow control of _____.	body temperature
139. Blood velocity in the skin can change _____ fold, depending on body temperature and the need to conserve or radiate heat.	
140. Unlike arteries in other areas of the body, arteries and arterioles in the pulmonary circuit have _____ walls and _____ lumens.	thin; large
141. In order to maximize blood flow to regions of the lungs that have the most oxygen, blood vessels in regions of the lung with low oxygen _____.	vasoconstrict
142. Nutrients and gases move across the capillary walls by _____.	diffusion
143. _____ forces fluid out of blood vessels and into the surrounding tissue.	Hydrostatic pressure (HP)
144. _____ is the main force causing fluid to move into blood vessels from the surrounding tissue, and opposing the tendency of fluid to leave the blood vessels.	Osmotic pressure (OP)
145. Osmotic pressure across capillary walls is due to _____ that are colloidally dispersed.	large molecules
146. The capillary colloidal osmotic pressure (abbreviated _____) is sometimes referred to as _____.	OPc; oncotic pressure
147. Because the hydrostatic pressure is due to blood pressure, it _____ as the distance from the heart increases.	decreases
148. _____ pressure falls as the distance from the heart increases, but _____ pressure, which is due only to the number of particles in solution, does not. Thus, fluid tends to leave the blood at the end of the capillaries that is _____.	Hydrostatic; osmotic; nearest the heart
149. The hydrostatic pressure and osmotic pressure of the interstitial fluid is _____.	quite low
150. Whether fluid will leave or enter the capillary is determined by the _____ pressure.	net filtration
151. Express net filtration pressure as a function of the net hydrostatic and osmotic pressures present in a given region of a capillary. (Be able to use this to predict whether fluid will enter or leave the capillary.)	NFP = (HPc - HPif) - (OPc - OPif); if greater than 0, fluid leaves capillary
152. Fluid that exits the bloodstream to enter the interstitial space is eventually returned to it by the _____ system.	lymphatic
153. _____ refers to a condition in which blood vessels are inadequately filled (pressure is too low) and blood cannot circulate.	Shock

154. _____ refers to the expression T = 2rP/t (that is, to the fact that tension against blood vessel walls is proportional to vessel radius and blood pressure, and inversely proportional to wall thickness).	Laplace's Law
155. If blood pressure falls too low, it reaches the _____, at which point there is not enough pressure to keep the vessels open and they collapse, stopping blood flow.	critical closing pressure
156. Shock due to blood loss is _____ shock.	hypovolemic
157. Shock caused by excessive dilation of the blood vessels is _____ shock.	vascular
158. _____ shock is a subtype of vascular shock which is due to a severe allergic reaction in which histamine is the agent causing the vasodilation.	Anaphylactic
159. _____ shock is a subtype of vascular shock due to toxins released by bacteria during a severe systemic infection.	Septic
160. _____ shock is a subtype of vascular shock due to failure of neural control.	Neurogenic
161. _____ shock is due to the inability of the heart to sustain output.	Cardiogenic
162. For women, the risk of heart attack rises dramatically after _____.	menopause
163. The most common cardiovascular disease in the young is _____.	hypertension
164. Fill in the missing terms in the following series: Left ventricle → ascending aorta → _____ → myocardium	coronary arteries
165. Fill in the missing terms in the following series: Left ventricle → _____ → _____ → _____ → right subclavian artery → right upper limb	ascending aorta; aortic arch; brachiocephalic trunk
166. Fill in the missing terms in the following series: Left ventricle → _____ → _____ → left subclavian artery → left upper limb	ascending aorta; aortic arch
167. Fill in the missing terms in the following series: _____ → _____ → _____ → RIGHT side of head, face, and neck	brachiocephalic trunk; right common carotid; right external carotid
168. Fill in the missing terms in the following series: _____ → _____ → _____ → LEFT side of head, face, and neck	aortic arch; left common carotid; left external carotid
169. Fill in the missing terms in the following series: aortic arch → left _____ → left _____ → Circle of Willis (Cerebral Arterial Circle)	common carotid; internal carotid
170. Fill in the missing terms in the following series: aortic arch → _____ → right _____ → right _____ → Circle of Willis (Cerebral Arterial Circle)	brachiocephalic trunk; common carotid; internal carotid

171. Fill in the missing terms in the following series: subclavian artery → _____ → _____ → Circle of Willis (Cerebral Arterial Circle) .... Of which side of the body is this true?	vertebral artery; basilar artery; both
172. The _____ receives blood from three major arteries, and has branches which supply the left and right sides of the brain.	Circle of Willis (Cerebral Arterial Circle)
173. Fill in the missing terms in the following series: (left or right) subclavian artery → (left or right) _____ → anterior thorax and trunk	internal thoracic artery
174. Fill in the missing terms in the following series: (left or right) _____ → chest, back, & proximal shoulder	subclavian artery
175. Fill in the missing terms in the following series: (left or right) _____ → (left or right) _____ → chest, back, & distal shoulder	subclavian artery; axillary artery
176. Fill in the missing terms in the following series: (left or right) subclavian artery → (left or right) _____ → (left or right) _____ → arm	axillary artery; brachial artery
177. Fill in the missing terms in the following series: (left or right) axillary artery → (left or right) _____ → (left or right) _____ → lateral forearm	brachial artery; radial artery
178. Fill in the missing terms in the following series: (left or right) axillary artery → (left or right) _____ → (left or right) _____ → medial forearm	brachial artery; ulnar artery
179. The _____ and _____ arteries both supply the palm of the hand via the _____, which in turn give rise to the _____ which supply the fingers.	radial; ulnar; palmar arches; digital arteries
180. Fill in the missing terms in the following series: abdominal aorta → _____ → _____ → spleen, stomach and pancreas	celiac trunk; splenic artery
181. Fill in the missing terms in the following series: abdominal aorta → _____ → _____ → stomach	celiac trunk; left gastric artery
182. Fill in the missing terms in the following series: abdominal aorta → _____ → _____ → liver, gallbladder, stomach, parts of small intestine	celiac trunk; common hepatic artery
183. Fill in the missing terms in the following series: abdominal aorta → _____ → cecum, ascending colon, transverse colon	superior mesenteric artery
184. Fill in the missing terms in the following series: abdominal aorta → _____ → diaphragm	inferior phrenic artery
185. Fill in the missing terms in the following series: abdominal aorta → (left or right) _____ → (left or right) adrenal gland	suprarenal arteries
186. Fill in the missing terms in the following series: abdominal aorta → (left or right) _____ → (left or right) kidney	renal artery
187. Fill in the missing terms in the following series: abdominal aorta → (left or right) _____ → (left or right) ovary or testis	gonadal artery

188. Fill in the missing terms in the following series: abdominal aorta → (left or right) _____ → lower back and abdominal wall	lumbar arteries
189. Fill in the missing terms in the following series: abdominal aorta → _____ → descending colon, sigmoid colon, and part of rectum	inferior mesenteric artery
190. Fill in the missing terms in the following series: abdominal aorta → (left or right) _____ → (left or right) _____ → pelvis, pelvic organs, genitals, hip	common iliac artery; internal iliac artery
191. Fill in the missing terms in the following series: abdominal aorta → _____ → lower vertebrae	median sacral artery
192. Fill in the missing terms in the following series: abdominal aorta → (left or right) _____ → (left or right) _____ → (left or right) _____ → thigh	common iliac artery; external iliac artery; femoral artery
193. Fill in the missing terms in the following series: (left or right) external iliac artery → (left or right) _____ → (left or right) _____ → knee	femoral artery; popliteal artery
194. Fill in the missing terms in the following series: (left or right) femoral artery → (left or right) _____ → (left or right) _____ → anterior leg	popliteal artery; anterior tibial artery
195. Fill in the missing terms in the following series: anterior tibial artery → _____ → foot	dorsalis pedis artery
196. Fill in the missing terms in the following series: (left or right) femoral artery → (left or right) _____ → (left or right) _____ → posterior leg	popliteal artery; posterior tibial artery
197. Fill in the missing terms in the following series: (left or right) femoral artery → (left or right) _____ → (left or right) _____ → (left or right) _____ → lateral leg and foot	popliteal artery; posterior tibial artery; fibular artery
198. Fill in the missing terms in the following series: (left or right) posterior tibial artery → (left or right) _____ → foot	plantar arteries
199. The _____ and _____ arteries branch to form the _____ arteries, which supply the toes.	dorsalis pedis; plantar; digital
200. Fill in the missing terms in the following series: blood from the brain → _____ → (left and right) _____ → (left and right) _____ → superior vena cava → heart	venous sinuses; internal jugular veins; brachiocephalic veins
201. Fill in the missing terms in the following series: blood from the (left or right) face and neck → (left or right) _____ → (left or right) subclavian veins → (left or right) _____ → superior vena cava	external jugular veins; brachiocephalic veins
202. Fill in the missing terms in the following series: blood from the (left or right) brain → (left or right) _____ → (left or right) _____ → superior vena cava	internal jugular veins; brachiocephalic veins
203. Blood from the anterior thorax and abdominal walls eventually enters the _____ veins before reaching the vena cava.	brachiocephalic
204. Blood from the RIGHT posterior thoracic wall and thoracic organs passes into the _____ and from there flows to the superior vena cava.	azygos vein

205. Blood from the LEFT posterior thoracic wall and thoracic organs passes into the _____ or _____ before entering the _____ and then flowing from there to the superior vena cava.	hemiazygos vein; accessory hemiazygos vein; azygos vein
206. Blood from the shoulder, chest, and back drains into two veins, the _____ and _____, and from there is transported to the brachiocephalic vein and on to the superior vena cava.	subclavian vein; axillary vein
207. Fill in the missing terms in the following series: blood from the superficial medial forearm → _____ → _____ → subclavian vein	basilic vein; axillary vein
208. Fill in the missing terms in the following series: blood from the superfical lateral forearm → _____ (→ _____ → _____) → axillary vein (The parentheses indicate that there are two alternate routes.)	cephalic vein; median cubital vein; basilic vein
209. Fill in the missing terms in the following series: thumb & fingers → _____ → _____ → _____ → axillary vein	digital veins; palmar arches; basilic vein
210. Blood returns from the capillary beds of the stomach, spleen, pancreas and intestines only after passing through the capillary beds of the _____ for _____.	liver; removal of nutrients and impurities
211. _____ circulation is circulation in which blood moves from one capillary bed to another without first being reoxygenated in the lungs.	Portal
212. Fill in the missing terms in the following series: the small intestine, cecum, ascending colon, and transverse colon → _____ → _____ → _____ → _____→ inferior vena cava	superior mesenteric vein; portal vein; liver; hepatic veins
213. Fill in the missing terms in the following series: the descending colon, sigmoid colon, and rectum → _____ → _____ → _____ → _____→ hepatic veins	inferior mesenteric vein; splenic vein; portal vein; liver
214. Fill in the missing terms in the following series: the spleen and pancreas → _____ → _____ → _____ → hepatic veins	splenic vein; portal vein; liver
215. Fill in the missing terms in the following series: stomach → _____ OR _____ → _____ → liver → hepatic veins	gastric vein; gastroepiploic (or gastroomental) vein; portal vein
216. Fill in the missing terms in the following series: RIGHT adrenal gland → _____ → inferior vena cava	right suprarenal vein
217. Fill in the missing terms in the following series: LEFT adrenal gland → _____ → _____ → inferior vena cava	left suprarenal vein; left renal vein
218. Fill in the missing terms in the following series: (left or right) kidney → (left or right) _____ → inferior vena cava	renal vein
219. Fill in the missing terms in the following series: RIGHT ovary or testis → right _____ → inferior vena cava	gonadal vein
220. Fill in the missing terms in the following series: LEFT ovary or testis → left _____ → left _____ → inferior vena cava	gonadal vein; renal vein
221. Fill in the missing terms in the following series: lower back and abdominal wall → (left or right) _____ → inferior vena cava	lumbar veins

222. Fill in the missing terms in the following series: pelvis, pelvic organs, genitals, and hip → (left or right) _____ → _____ → inferior vena cava	internal iliac vein; common iliac vein
223. Fill in the missing terms in the following series: thigh → _____ → _____ → _____ → inferior vena cava	femoral vein; external iliac vein; common iliac vein
224. Fill in the missing terms in the following series: knee → _____ → _____ → _____ → comon iliac vein	popliteal vein; femoral vein; external iliac vein
225. Fill in the missing terms in the following series: deep anterior leg → _____ → _____ → _____ → external iliac vein	anterior tibial veins; popliteal vein; femoral vein
226. Fill in the missing terms in the following series: deep posterior leg → _____ → _____ → _____ → external iliac vein	posterior tibial veins; popliteal vein; femoral vein
227. Fill in the missing terms in the following series: deep lateral leg → _____ → _____ → popliteal vein	fibular veins; posterior tibial veins
228. Fill in the missing terms in the following series: superficial posterior leg → _____ → _____ → _____ → external iliac vein	small saphenous vein; popliteal vein; femoral vein
229. Fill in the missing terms in the following series: superficial medial leg and thigh → _____ → _____ → external iliac vein	great saphenous vein; femoral vein
230. Fill in the missing terms in the following series: toes → _____ → _____ and _____ → several veins	digital veins; dorsal veins of the foot; plantar veins
231. The anterior and posterior tibial veins, fibular veins, and great and small saphenous veins all help to drain venous blood from the _____ and _____.	dorsal veins of the foot; plantar veins

The Lymphatic System

1. The lymphatic system collects _____ and _____ from interstitial regions and returns them to the blood.	fluid; proteins
2. Lymphatic capillaries are extremely _____ and they can therefore collect not only fluid but also proteins and even cells.	porous
3. Specialized lymphatic capillaries participate in digestion by absorbing _____.	lipids and lipid-soluble substances
4. One of the major functions of the lymphatic system is to _____ the interstitial fluid.	purify
5. One of the lymphatic system's tasks is to destroy cells which are not normally found in the body, but sometimes it is unsuccessful in destroying _____; it is not uncommon for these cells to invade lymphatic tissue and begin to grow.	cancer cells
6. The fluid in the lymphatic system is called _____.	lymph
7. About 3 liters per _____ travels through the lymphatic system, compared with 5 liters per _____ through the circulatory system.	day; minute
8. Lymph can flow in only one direction because of _____ in the lymphatic vessels.	one-way valves
9. Lymph is primarily propelled toward the site where it is returned to the blood by _____, although _____ in the vessel walls also participates.	the motions of the body; smooth muscle
10. The smallest lymphatic vessels are called _____ and are essentially microscopic, dead-end tubes.	lymphatic capillaries
11. Endothelial cells that make up the lymph capillaries overlap loosely to form _____.	one-way valves
12. Increased fluid pressure in regions surrounding lymph capillaries causes the overlapping regions of the cells of the capillaries to _____.	separate
13. High pressures in the lymph fluid within the lymphatic capillaries cause the overlapping regions of the cells of which the capillaries are made to _____.	press together
14. Lymphatic capillaries are prevented from collapsing as tissue fluid increases by anchoring _____ attached to the endothelial cells of the vessel.	collagen filaments
15. _____ are specialized lymph capillaries in the _____ of the small intestine.	Lacteals; villi
16. Most lymph in the body appears _____, but that in lacteals (called _____) is creamy white due to the high concentration of lipids.	clear; chyle
17. When several lymph capillaries merge, they form a(n) _____.	lymphatic collecting vessel

18. The walls of lymphatic collecting vessels, like those of blood vessels, have _____ <how many> tunics.	three
19. When lymphatic collecting vessels merge, they form _____.	lymphatic trunks
20. There are nine major lymphatic trunks: two each of the _____, _____, _____ and _____ trunks, and one of the _____ trunk.	lumbar; jugular; subclavian; bronchomediastinal; intestinal
21. When lymphatic trunks merge, they form the largest lymphatic vessels in the body, the _____. (There are only _____ <how many> of these in the body; in some individuals, the _____ one is absent and several trunks drain into the venous system directly.)	lymphatic ducts; two; right
22. Lymph from the legs, several abdominal organs and the lower torso enters the left lymphatic (a.k.a. thoracic) duct via a dilated sac called the _____.	cisterna chyli
23. The left and right lymphatic ducts drain into the left and right _____ veins, at their intersection with the _____.	subclavian; jugular veins
24. Blood is prevented from entering the lymphatic ducts by the presence of _____.	one-way valves
25. The _____ collects lymph from the bulk of the body, including one entire side of the body and regions on the opposite side below the thorax.	left thoracic lymphatic duct
26. The _____ collects lymph only from a small portion of one side of the body.	right lymphatic duct
27. One major class of white blood cells, the _____, take their name from their presence in the lymphatic system.	lymphocytes
28. One major class of lymphocytes, the _____, are formed in the bone marrow, but mature in the thymus gland.	T-cells or T lymphocytes
29. _____ attack cells in the body that are not recognized as normal members of the body's cellular community.	T-cells or T lymphocytes
30. _____ are a type of blood cell that develops and matures in the bone marrow before moving to the lymphatic system.	B-cells or B lymphocytes
31. A(n) _____ is any large molecule with a unique shape which can be recognized by the immune system.	antigen
32. When _____ encounter an antigen, they divide to form plasma cells and memory cells.	B-cells or B lymphocytes
33. _____ release antibodies which bind to antigens.	Plasma cells
34. _____ circulate in the lymph and blood for many years, and respond rapidly if an antigen encountered in the past is again encountered.	Memory cells

35. Many _____, cells that are descended from monocytes and which engulf microbes and debris, are found in the lymph fluid.	macrophages
36. The lymphatic system's supporting structure is provided largely by _____ cells and the fibers they produce.	reticular
37. Lymphatic tissues are classified depending on the _____ and whether or not it is surrounded by a(n) _____.	distribution of the cells; capsule
38. Lymphatic tissues in the _____ (a vascular layer of connective tissue under the basement membrane of epithelium, particularly mucosal epithelium), in general, are referred to as _____.	lamina propria; mucosa-associated lymphoid tissue (MALT)
39. When MALT is found in the gastrointestinal tract, it is referred to as _____.	gut associated lymphoid tissue (GALT)
40. _____ is lymphatic tissue in which lymphocytes and macrophages are only loosely associated with the reticular fiber network, and which is not clearly separated from surrounding tissues.	Diffuse lymphatic tissue
41. Diffuse lymphatic tissue is found in the mucous membranes of the _____ and _____ systems.	respiratory; digestive
42. _____ are groups of lymphatic cells which have clear boundaries but which are not protected by a capsule. When these are located in lymph nodes or the spleen, they are more commonly called _____.	Lymphatic nodules; lymphatic follicles
43. Lymphatic nodules are found in the _____ of the mucous membranes that line the _____, _____, _____ and _____ tracts.	lamina propria; gastrointestinal; reproductive; respiratory; urinary
44. _____ are several-centimeter wide clusters of lymphatic noduless in the lining of the ileum.	Peyer's patches
45. The _____ consist of a set of _____ <how many> clusters of lymphatic nodules, arranged in a ring, in the mucosa of the pharynx.	tonsils; seven
46. The _____ is the tonsil found in the rear wall of the nasopharynx.	adenoid or pharyngeal tonsil
47. The _____ are the tonsils found on each side of the pharynx.	palatine
48. The pair of tonsils at the base of the tongue are the _____ tonsils.	lingual
49. The two tonsils in the pharynx that guard the entrance to the pharyngotympanic tube (also called the auditory tube) are the _____ tonsils.	tubal
50. Encapsulated organs which contain both lymphatic nodules and diffuse lymphatic tissue are the _____, _____ and _____.	lymph nodes; thymus; spleen
51. Connective tissue projecting into encapsulated lymphatic organs forms _____, which act as supporting structures.	trabeculae

52. _____ are the small, roughly oval structures that occur along lymphatic vessels.	Lymph nodes
53. Lymph nodes are most abundant where _____ merge.	lymphatic vessels
54. Lymph enters a lymph node through _____ which enter the _____ side of the node.	afferent lymphatic vessels; convex
55. Lymph leaves a lymph node through _____ which exit within an indentation called the _____, on the _____ side of the node.	efferent lymphatic vessels; hilum or hilus; concave
56. In lymph nodes, _____ are strands of reticular fibers around which lymphocytes and macrophages cluster and which extend from the cortex toward the hilus (hilum).	medullary cords
57. _____ are open spaces within lymph nodes through which lymph flows.	Lymphatic sinuses
58. One of the functions of the lymph nodes is to filter out _____ or _____.	impurities; microorganisms
59. One of the functions of the lymph nodes is to house _____, which destroy _____, _____ and _____.	macrophages; bacteria; toxins; debris
60. _____ within the lymph nodes screen the lymph as it enters, and differentiate to produce _____ if an antigen is detected.	B-cells; antibodies
61. B-cells and macrophages proliferate in the _____ of lymph nodes.	cortex or outer layer
62. T-cells are found in lymph nodes, primarily in the _____.	medulla
63. The _____ is a lymphatic organ located between the lungs, immediately anterior to the heart.	thymus
64. The thymus is largest during _____.	early childhood
65. An individual whose thymus was so small that it could not be found at autopsy was most likely _____.	old
66. The thymus has _____ <how many> lobes.	two
67. Each lobe of the thymus is surrounded by a(n) _____.	capsule
68. _____ are the divisions within the thymic lobe produced by inward extensions of the capsule.	Lobules

69. Each thymic lobule has two distinct regions: the _____ and the _____.	cortex; medulla
70. The lymphocytes which are found in the thymus are almost exclusively _____.	T-cells or T lymphocytes
71. _____ are rounded clusters of cells composed of epithelium; their function is unknown.	Thymic corpuscles (or Hassall's corpuscles)
72. The major function of the thymus is to produce _____.	mature T lymphocytes (or mature T-cells)
73. The blood vessels that supply the thymus are surrounded by _____ which limit the access of immature T-cells to antigens.	epithelioreticular cells
74. The largest lymphatic organ is the _____.	spleen
75. Blood vessels, nerves, and lymphatic vessels enter the spleen through the _____, which is on the upper surface.	hilus or hilum
76. Reticular fibers and lymphocytes in the spleen form nodules which resemble those of lymph nodes and which are called _____.	white pulp
77. Most of the blood delivered to the spleen does not pass directly from arteries to veins via capillaries, but instead passes through a region of _____ circulation which has no direct connection between the arterial and venous vessels.	open
78. Blood passing the regions in the spleen in which circulation is open enters the venous system by first entering _____.	venous sinuses
79. The venous sinuses within the spleen, together with the associated fibrous network known as the _____, are called _____.	splenic cords; red pulp
80. Splenic cords consist of _____, _____ and _____ which act to filter the blood.	reticular connective tissue; macrophages; lymphocytes
81. The spleen has five major functions, one of which is to filter the _____.	blood
82. The spleen has five major functions, one of which is to destroy _____ and capture iron and amino acids for recycling.	old RBCs
83. The spleen has five major functions, one of which is to provide a reservoir for _____.	blood
84. The spleen has five major functions, one of which is to provide a location for _____ and _____ to proliferate.	B-cells; T-cells
85. The spleen has five major functions, one of which is to help with the production of _____ during fetal development.	blood cells

86. Although the lymphatic system is nearly as extensive as the circulatory system, lymph capillaries are absent in _____, _____, _____ and the _____. These depend on other routes for lymph drainage.	bones; teeth; bone marrow; CNS

The Immune System

1. The body has three lines of defense against attack by foreign invaders: _____, _____ and _____.	non-specific barriers; non-specific defenses; specific defenses
2. The skin is an example of a(n) _____. Physically, the outer layer is highly-cross-linked keratin and is waterproof, blocking many invaders and their toxins.	non-specific barrier
3. Invaders not only have difficulty penetrating the skin's structure, they are also repelled or destroyed by the skin's _____.	acidic secretions
4. Tears, saliva, and other secretions include lysozyme which _____.	breaks down bacterial walls
5. Mucous membranes and the cells that line them serve as a(n) _____: invaders become trapped in the mucous and are swept out by _____.	non-specific barrier; ciliated cells
6. Most microbes living in the food (or drink) which we ingest are destroyed by _____ before they can cross into the body: this is a(n) _____.	gastric juices; non-specific barrier
7. _____ are found on many bodily surfaces; they remove nutrients and other materials that would otherwise be available to pathogenic species.	Symbiotic bacteria
8. The second line of defense in the immune system uses _____ to attack a(n) _____ invader.	chemical and cellular methods; unrecognized
9. Lymphocytes which mature in the lymph system (as opposed to in the marrow or thymus) are called _____, and are a part of the non-specific defense system.	natural killer (NK) cells
10. _____ recognize cells whose surface markers are drastically “non-self” - missing major markers or containing non-human glycoproteins - and kill them. (They [are/are not?] phagocytic.)	NK cells; are not
11. Neutrophils and macrophages ingest _____, and so play a role in non-specific defenses.	foreign material and debris
12. Macrophages sometimes kill their prey with chemicals including peroxide and bleach in a process called _____.	the respiratory burst
13. A set of about 20 proteins present in the blood that, when activated, bind to pathogens and both _____ and _____ are called “complement.”	attract phagocytes; disrupt the pathogen’s membranes
14. In the “classical pathway” for complement activation, complement proteins recognize _____.	antibodies bound to antigens
15. In the “alternative pathway” for complement activation, complement proteins recognize _____.	polysaccharides on a microorganism's surface
16. "Viral infections" are infections in which viral _____ enter the cell, and the cell is forced to make _____ instead of, or in addition to, its own.	nucleic acids; viral proteins
17. Many cells, after being infected by a virus, manage to secrete _____ which stimulate neighboring cells to resist viral infection and ultimately signal the immune system.	interferons (IFNs)

18. _____ is a systemic response in which cellular metabolism is accelerated and which creates a hostile environment to the invader: the danger is that, if excessive, it may also damage host tissue.	Fever
19. The four signs of acute inflammation are _____, _____, _____, and _____.	redness; heat; swelling; pain
20. The inflammatory response is a(n) _____.	non-specific defense
21. The inflammatory response is initiated when _____ and nearby circulating cells.	chemicals are released by injured cells
22. Vasodilation increases _____ and causes redness and heat.	blood flow
23. Increased _____ causes local edema; this in turn causes swelling and pain.	capillary permeability
24. Increased capillary permeability allows clotting factors to leak into the interstitial fluid: as a result _____.	pathogens become trapped in the resulting fibrin mesh
25. Phagocytes and lymphocytes are attracted to the signals released by damaged tissue in a process called _____.	chemotaxis
26. _____ (white blood cell production) is increased in response to signals released by _____ during the inflammatory response.	Leukopoiesis; damaged tissue
27. _____ is produced by the liver. This protein has several functions in immunity; it is used as a diagnostic tool, since its presence indicates that _____.	CRP (C-reactive protein); inflammation is present somewhere in the body
28. As leukocytes approach the injury, they begin to _____, rather than floating freely in the blood. This process is called _____.	cling to the capillary walls and 'walk' along them; margination
29. When leukocytes find the damaged region, they _____ into the interstitial area in a process called _____.	squeeze through the permeable capillaries; diapedesis
30. If the body is able to recognize an invader, a third line of defense is available: the _____ of the immune system.	specific (or adaptive) branch
31. Adaptive immunity requires five tasks: _____, _____, _____, _____ and _____.	recognition; lymphocyte selection; lymphocyte activation; destruction; memorization
32. One task of the immune system is recognition of alien (_____) cells. To assist in this task, self cells include proteins in their plasma membrane called _____ proteins which serve as a highly recognizable uniform.	non-self; major histocompatibility complex (MHC)
33. The MHC proteins are also called the _____.	human leukocyte antigen (HLA)
34. Proteins for the MHC originate from 20 _____ with over 50 _____ each, so that no two individuals will have the same MHC.	genes; alleles

35. During the construction of the MHC _____ are incorporated. Abnormal proteins in the MHC are recognized by T-lymphocytes as “non-self.”	small pieces of proteins from within the cell
36. There are two types of MHC: MHCI is displayed by _____, but MHCII is presented by _____. The latter carries the news of the infection throughout the body or serves to signal that help is needed in an infected region.	all body cells; cells within the immune system only
37. Cells that present the MHCI are doing to so say, in essence, “Look what I _____.”	made
38. Antigen presenting cells are phagocytes that have _____ <done what?>. They break down antigens and _____.	ingested an invader; incorporate pieces into MHCII
39. Cells that present the MHCII are doing to so say, in essence, “Look what I _____.”	ate
40. Cells that present the MHCII are called _____.	antigen presenting cells, or APCs
41. In 2011, a Nobel prize was awarded for work describing one type of _____, the dendritic cell.	APC OR antigen presenting cell
42. Dendritic cells are produced in the bone marrow and migrate to _____.	peripheral tissues and organs
43. Dendritic cells in peripheral tissue _____ but cannot yet activate T-cells, and so are said to be immature.	phagocytose pathogens
44. Dendritic cells that have phagocytosed a pathogen migrate to _____, maturing on the way.	lymph nodes
45. Once mature, dendritic cells are no longer phagocytic; instead, they specialize in _____, and activating them.	presenting antigens to T-cells
46. _____ can be recognized by antibodies or lymphocyte receptors without modification.	Complete antigens
47. Antigens are often large, and may have many sites (called _____ or _____) to which antibodies or lymphocyte receptors may bind.	antigenic determinants; epitopes
48. Haptens are _____ that are too small to _____, but which may interact with proteins of the body and then may be recognized as potentially harmful.	incomplete antigens; stimulate the immune response
49. The cells responsible for distinguishing self from non-self cells are the _____.	lymphocytes
50. Each lymphocyte can recognize _____ <how many?> antigens, and so the body’s ability to recognize many different antigens depends on having _____.	one single; many different lymphocytes
51. _____ involves recognition of an antigen by a specific lymphocyte, after which the lymphocyte is ready for activation.	Lymphocyte selection

52. Lymphocytes remain inactive and do not proliferate until _____ and (usually) a co-stimulator sensed.	an antigen is recognized
53. Activation of a lymphocyte refers to the cell's commitment to proliferate. Since each daughter cell recognizes the same antigen, the process is called _____.	clonal selection
54. Since each antigen may have several sites to which antibodies may bind, more than one B-cell clone may produce antibodies to each antigen. A collection of such antibodies is said to be _____.	polyclonal
55. If one single B-cell is cloned in the laboratory by selection against one single antigenic determinant on an antigen, only one type of antibody is produced. Such antibodies are said to be _____.	monoclonal
56. Most lymphocytes, in order to become activated after an antigen binds, must also bind to a(n) _____. This serves as a "double-check" to prevent _____.	co-stimulator; accidental activation
57. _____ or _____ act as co-stimulators.	Chemicals released by nearby cells; membrane proteins on the non-self or abnormal cell
58. Killer T-cells, as part of the adaptive immune response, _____ and _____ the pathogen directly. They are also called _____ cells, because of the type of receptor on their surface.	recognize; attack; CD8
59. Antibodies bound to a pathogen trigger attacks by _____.	the innate immune system
60. When activated lymphocytes proliferate, some of the daughter cells are always _____: they must _____ if they are to become activated.	inactive; bind antigens
61. _____ are immunocompetent (mature) lymphocytes created during an infection. They remain alive long after the infection, allowing the body to "remember" the antigen and react quickly if it returns.	Memory cells
62. Memory cells express _____ that was expressed by the parent lymphocyte.	the same antigen receptor
63. For the body to mount a specific defense against a newly encountered invader takes _____ <how long?>. (There may be only a single lymphocyte in the body that happens to bind to it!)	days or weeks
64. The response to a newly encountered invader is called the _____.	primary immune response
65. Re-exposure, even years later, to an antigen that has been responded to before results in a specific defense that takes _____ to mount. This is due to the presence of _____. (There are thus many lymphocytes in the body that are able to bind to the antigen.)	only hours; memory cells
66. The response to an invader that has been attacked in the past is called the _____.	secondary immune response
67. Once a lymphocyte is capable of binding to a specific antigen, it is said to be _____ or _____.	mature; immunocompetent
68. Immunocompetent lymphocytes have a set of _____ on their surface which can bind to a specific antigen.	receptors

69. The antigen binding receptors of lymphocytes are produced by the _____ that produce them, so that the number that can be made by a single person is very large.	shuffling of portions of the genes
70. Immature lymphocytes are formed from hematopoietic stem cells in the _____.	bone marrow
71. Each immature lymphocyte displays _____, but most such cells are unwanted.	a single antigen-binding receptor
72. Lymphocytes whose antigen receptors do NOT react with 'self' cells are said to be _____, but many immature lymphocytes do not meet this standard.	tolerant
73. Most B-cells whose receptors bind to “self” proteins are destroyed in _____.	the bone marrow
74. In the thymic cortex, immature T-cells that _____ are allowed to survive until the next stage: those that can’t, die. (+ binding = live) This is called _____ selection.	recognize “self” MHC proteins; positive
75. In the thymic medulla, immature T-cells whose antigenic receptor binds to _____ are killed (- binding = live). This is called _____ selection.	“self” proteins displayed by the MHC; negative
76. The acquired immune response can be divided into two branches: the _____ response recognizes antigens or pathogens that are not associated with any “self” cells.	humoral
77. The acquired immune response can be divided into two branches: the _____ response recognizes antigens that are associated with “self” cells (such as virally infected cells, or antigen presenting cells).	cell-mediated
78. Humoral immunity is mediated by _____ produced by plasma cells present in the body’s “humors” or fluids.	antibodies
79. B-cells recognize antigens that are _____: that is, that are not displayed as part of a MHC.	free in the body
80. The first response in the humoral branch of the immune response is _____.	the binding of a B-cell to an antigen
81. When a B-cell encounters an antigen and has been activated, it proliferates into two types of cells: _____ and _____.	plasma cells; memory cells
82. Plasma cells produce antibodies that can bind to _____.	the same antigen that was recognized by the parent B cell
83. Antibodies are produced by _____ in the lymph.	plasma cells
84. Antibodies are _____, each of which can bind to _____ identical antigens.	proteins; two or more
85. Most antibodies are essentially Y-shaped: the stem of the Y is _____ and the branches of the Y are _____ and are called the _____.	constant; variable; variable region
86. It is the differences in the _____ that enables different antibodies to bind to different antigens.	variable region

87. _____ refers to the fact that antibodies “get in the way,” so to speak, interfering with the function of the proteins or cells to which they bind.	Neutralization
88. _____ refers to the fact that, since each antibody can bind to two antigen molecules, they can cause the antigen (or cells which display it) to clump. This makes them vulnerable to _____.	Agglutination; the non-specific immune system
89. Elements of the non-specific immune system, including macrophages and complement proteins, recognize antibodies in the body which _____. This results in the destruction of the antigen.	have bound to an antigen
90. Although Y shaped, compared to fibrous proteins, antibodies are round or globe shaped. Thus, antibodies are called the _____.	immunoglobulins (Ig)
91. Antibodies are divided into five classes based on their structure: _____, _____, _____, _____ and _____.	IgA; IgD; IgE; IgG; IgM
92. Most _____ is found as a dimer (two stuck together) in body secretions, and helps to _____.	IgA; prevent pathogens from attaching to the body’s surface
93. _____ serves as an antigen receptor for B-cells: it is physically attached to their surface.	IgD
94. _____ is found in barrier regions, bound to mast cells and basophils: antigen binding causes the cells to _____.	IgE; release histamine and other inflammatory chemicals
95. Most antibodies are _____. When bound to an antigen, these are recognized by other components of the immune system, which then _____.	IgG; destroy the object to which it is bound
96. The monomer form of _____, like IgD, serves as an antigen receptor for B-cells.	IgM
97. As a pentamer (five units bound together), _____ is the first antibody released by new plasma cells and so can serve as a marker for an active infection.	IgM
98. Like IgG, when bound to an antigen, the pentameric form of _____ is recognized by other components of the immune system which destroy the object to which it is bound.	IgM
99. _____ is mediated by T lymphocytes which respond only to living cells which display both _____ and _____.	Cell mediated immunity; foreign antigens; “self” (MHC) proteins
100. When T-cells bind to a non-self cell and are activated, they proliferate, leading to the production of _____, _____, _____ and _____ T cells.	killer; helper; suppressor; memory
101. Killer T-cells are also called _____ cells or _____ cells.	cytotoxic T; CD8
102. Killer T-cells recognize MHCI proteins mixed with antigens, and respond by _____.	producing toxins which cause the infected cells to die
103. Helper T-cells are also called _____ cells, because of the major receptor they express on their surface.	CD4

104. The function of helper T-cells is to stimulate B-cells to _____, and to stimulate both B-cells and T-cells to _____. (That is, they produce co-stimulators.)	produce antibodies; divide
105. Without _____ there can be no adaptive immune response.	helper T-cells
106. An interleukin is a type of cytokine which is released by _____ and allows communication between leukocytes (inter-leukocyte communication). Interleukin is a co-stimulator and activates _____.	helper T-cells and APCs; antigen-bound lymphocytes
107. _____ are needed at the end of an infection to shut down the immune response.	Suppressor T-cells
108. _____ are the most similar to the parent T-cell: they remain in circulation long after the infection is over, ready to recognize the pathogen if it returns.	Memory T-cells
109. One way that we medically supplement the immune response is to directly kill the pathogen (if it is bacterial or eukaryotic) by the use of _____.	antibiotics
110. One way that we medically supplement the immune response is to inject _____ that are _____ the pathogen, so that the body will recognize it in the future. (This is called vaccination.)	harmless antigens; derived in some way from
111. One way that we medically supplement the immune response is to directly transfer antibodies from one individual to another: this confers _____.	passive immunity
112. The immunity created by our own immune system is called _____.	active immunity
113. Newborn infants have passive immunity to many pathogens due to _____.	transfer of maternal antibodies through the placenta
114. Transplant success depends on the similarity of the tissues because cytotoxic T-cells, NK cells, and antibodies work to _____.	destroy non-self tissues
115. Autografts are tissue grafts transplanted from _____.	one body site to another in the same person
116. Allografts are grafts transplanted from _____. Currently, to be successful, the immune system must be suppressed.	individuals that are not genetically identical but belong to the same species
117. Xenografts are grafts _____. Currently, to be successful, the immune system must be suppressed.	taken from another animal species
118. _____ are any congenital or acquired conditions that cause immune cells, phagocytes, or complement to behave abnormally.	Immunodeficiencies
119. Severe combined immunodeficiency (SCID) is a congenital condition that produces a deficit of _____.	lymphocytes
120. Acquired immune deficiency syndrome (AIDS) cripples the immune system by interfering with _____.	helper T-cells

121. _____ occur when the immune system loses its ability to differentiate between self and non-self. As a result, the body _____.	Autoimmune diseases; attacks its own cells
122. Hypersensitivities, or allergies, are the result of the immune system causing tissue damage as it attacks _____.	a harmless substance

1. The nose is divided into the _____, which is formed by hyaline cartilage and bones of the skull, and the _____, which is entirely within the skull.	external nose; nasal cavity
2. The nasal cavity is lined by two types of epithelium: _____ and _____.	olfactory mucosa; respiratory mucosa
3. The _____ divides the nasal cavity into right and left sides.	septum
4. The nostrils are also known as the _____ (singular, _____).	nares; naris
5. Air entering the nose encounters the _____, which create turbulence and increase the chances that airborne contaminants will contact the nasal mucosa rather than passing into the lungs.	nasal conchae
6. The nasal cavity is surrounded by _____ within the frontal, maxillary, sphenoid, and ethmoid bones that serve to lighten the skull, warm and moisten air, and produce mucus.	paranasal sinuses
7. Hair, mucus, and cilia which line the nasal cavity prevent _____.	dust and debris from entering the lungs
8. After leaving the internal nasal cavity, air enters the _____, which can be divided into three regions, the _____, _____ and _____.	pharynx; nasopharynx; oropharynx; laryngopharynx
9. The _____ is the region of the pharynx which serves only as an air passageway.	nasopharynx
10. The _____ contains the lymphatic pharyngeal tonsil (adenoid), which traps and destroys airborne pathogens, and the pharyngeal opening of the auditory tube.	nasopharynx
11. The _____ is an air, food drink passageway that extends inferiorly from the level of the soft palate to the epiglottis.	oropharynx
12. The _____ is an air, food and drink passageway that lies directly behind the epiglottis, extends to the larynx, and is continuous inferiorly with the esophagus.	laryngopharynx
13. Food and air are sorted into the stomach or lungs, respectively, in the _____ region of the pharnyx.	laryngopharynx
14. The casual phrase 'voice box' refers to the _____.	larynx
15. The superior boundary of the larynx is the _____ bone, above which is the laryngopharynx. Inferior to the larynx is the _____.	hyoid bone; trachea
16. At the top of the larynx, the _____ acts as a flexible flap that prevents food from entering the larynx.	epiglottis
17. The uppermost region of the larynx consists of the vocal cords and the space between them, and is called the _____.	glottis

18. The structure on the neck commonly called the Adam's apple is the _____.	thyroid cartilage
19. Folded mucous membranes cross from the thyroid cartilage in the front to the _____ cartilages in the back.	arytenoid
20. The upper pair of mucous membranes which connect the thyroid cartilage to the arytenoid cartilages are the _____ (also called _____).	false vocal cords; vestibular folds
21. The lower pair of mucous membranes which connect the thyroid cartilage to the arytenoid cartilages are the _____.	true vocal cords
22. _____ form the core of the true vocal cords, and vibrate as air passes over them to produce sound.	Vocal ligaments
23. When someone increases intra-abdominal pressure during periods of effort, they close the _____. (This is called _____.)	glottis; Valsalva's maneuver
24. The cricoid cartilage and pairs of corniculate and cuneiform cartilages are supporting structures of the _____.	larynx
25. The trachea, or windpipe, descends from the larynx into the _____, where it ends by dividing to give rise to the _____.	mediastinum; primary bronchi
26. The posterior wall of the trachea adjoins the anterior wall of the _____.	esophagus
27. The trachea is lined with mucus-producing goblet cells and pseudo-stratified ciliated epithelial cells, which together function to _____.	sweep debris away from the lungs
28. The sub-mucosa in the trachea is _____ tissue.	areolar connective
29. 16-20 rings made of hyaline cartilage prevent the trachea from _____.	collapsing during inspiration
30. The cartilaginous layer of the trachea is covered by _____ and is called the _____.	areolar connective tissue; adventitia
31. The trachea ends inferiorly by dividing to give rise to the _____ (singular: _____).	primary bronchi; primary bronchus
32. The primary bronchi divide to form the _____, and these in turn divide to form the _____.	secondary bronchi; tertiary bronchi
33. The secondary bronchi are sometimes called the _____ bronchi because there is one for each _____ of the lungs.	lobar; lobe
34. The tertiary bronchi are sometimes called the _____ bronchi because there is one for each _____ of the lungs.	segmental; segment

35. Bronchi continue to branch until they form _____, tubes which are less than 1mm in diameter.	bronchioles
36. The supporting cartilage that is required in the trachea and bronchi gradually changes in character as the tubes become smaller, and by the time _____ are reached, the cartilage is absent.	bronchioles
37. The walls of the bronchioles are made of _____.	smooth muscle
38. The portions of the respiratory system which deliver air to the regions of the lungs in which gas exchange can occur are the _____ regions.	conducting
39. _____ are the last bronchioles through which air passes before reaching the respiratory regions of the lungs.	Terminal bronchioles
40. Regions of the lungs which are capable of exchanging gases between blood and air are the _____ regions.	respiratory
41. Bubble-like structures called _____ (singular: _____) are the structures in which gas exchange occurs.	alveoli; alveolus
42. Only air in the _____ participates in gas exchange: air in other parts of the lungs cannot.	alveoli
43. Respiratory bronchioles themselves have several _____ on their surface, but they are still large enough to divide once again to form _____.	alveoli; alveolar ducts
44. Although not generally referred to in this way, a(n) _____ may be thought of as the smallest respiratory bronchioles: it does not subdivide, and has many alveoli on its surfaces.	alveolar duct
45. _____, which are found at the end of each alveolar duct, are chambers connected to several alveoli.	Alveolar sacs
46. Pores connect adjacent alveoli to allow air pressure to be _____, and to provide alternate routes for airflow in case one or more alveoli _____.	equalized; collapse
47. Gas exchange occurs across the respiratory membrane, which consists of _____ and _____.	alveoli; capillary walls
48. The walls of alveoli contain two cell types: _____ and _____.	Type I pneumocytes; Type II pneumocytes
49. Type I pneumocytes are _____ cells.	simple squamous epithelial
50. The shape of Type I pneumocytes allows _____.	gas to diffuse easily across them
51. Type II pneumocytes are cuboidal cells which produce a chemical that is needed to _____.	prevent the alveoli from collapsing

52. In order to prevent airborne bacteria which reach the alveoli from becoming a problem, _____ patrol the alveolar surfaces.	macrophages
53. The _____ lung is divided into two lobes.	left
54. The _____ lung is divided into three lobes.	right
55. The lobes of the lungs are further divided to form _____ segments; to each of these, air is delivered by a single _____.	bronchopulmonary; tertiary bronchus OR segmental bronchus
56. Bronchopulmonary segments are subdivided to form _____; to each of these, air is delivered by a(n) _____.	lobules; terminal bronchiole
57. The top of the lung is the _____; the bottom, the _____.	apex; base
58. The _____ surface is the surface at which a lung meets the ribs.	costal
59. Each bronchopulmonary segment is served by its own _____, _____ and _____.	artery; vein; tertiary bronchus
60. Serous membranes which surround the lungs are called the _____.	pleura
61. Each lung is surrounded by its own _____ and connected to the mediastinum by vascular and bronchial attachments called the _____.	pleural cavity; lung root
62. The parietal pleura covers the thoracic wall, superior face of the diaphragm, and continues _____, forming the boundary of the _____.	around the heart between the lungs; mediastinum
63. Blood vessels, bronchi, nerves, and lymphatic vessels enter the lungs at the _____, which is found on the _____ surface.	hilus; medial or mediastinal
64. There are two circulations that serve the lungs: the _____ and _____.	pulmonary network; bronchial arteries
65. The pulmonary network carries _____.	blood to the lungs for oxygenation
66. The bronchial arteries provide _____.	oxygenated blood to the trachea and bronchi
67. The lungs have two lymphatic supplies: the superficial lymphatic vessels drain lymph from _____.	the outer lung and the pleura
68. The lungs have two lymphatic supplies: the deep lymphatic vessels drain lymph from the _____.	bronchi and from the lungs' connective tissues

69. In the alveoli, lymphatic vessels are _____.	absent OR not found
70. The lungs are innervated by _____ motor fibers that constrict or dilate the airways, as well as sensory fibers.	autonomic
71. _____ means, quite simply, breathing. _____ means to breathe in, while _____ refers to breathing out.	Pulmonary ventilation; Inspiration; expiration
72. _____ is the process of gas exchange between the blood and the lungs.	External respiration
73. _____ is the process of gas exchange between the fluids of the body and the cells.	Internal respiration
74. _____ is the process by which cells produce ATP, producing water and carbon dioxide as wastes and using oxygen as an electron acceptor.	Cellular respiration
75. For a gas, changing the pressure results in a change in volume such that the product of the pressure and volume is unchanged: $P_{initial}V_{initial} = P_{final}V_{final}$. (Thus, if you increase pressure, volume will _____.) This is known as _____.	decrease; Boyle's Law
76. When the volume of the lungs is increased, the _____ inside the lungs will decrease until 'pressure times volume' returns to its original value. (This is an application of _____.)	pressure; Boyle's Law
77. Gas molecules are very far apart, and gas pressure is simply due to the _____ and _____ of gas molecules hitting a surface at a given instant.	number; velocity
78. The gas pressure due to a single component of a mixture is the _____ of that component; the total pressure in the system is the sum for all components. Example: in an equal mixture of oxygen and nitrogen, pressure due to each is 1/2 of the total.	partial pressure
79. The fact that the total pressure in a system composed of several gases is the sum of the pressures due to each individual gas is called _____.	Dalton's Law
80. The greater the number of gas particles that are hitting the surface of a liquid, the greater the _____. This is known as _____.	diffusion of the gas into the liquid; Henry's Law
81. Air (or any gas) will flow from a region of _____ to a region of _____.	high pressure; low pressure
82. Three factors influence the amount of gas which will dissolve in a liquid: _____, _____ and _____.	partial pressure; solubility; temperature
83. The greater the difference in partial pressures for a gas across a permeable boundary, the faster the _____ across it.	diffusion
84. The greater the surface area of a permeable boundary, the faster the _____ across it.	diffusion
85. A droplet of water has far fewer molecules of water in contact with _____ than either a bubble of water or a flat sheet of water.	air

86. Water tends to form droplets instead of to flatten out. This is true because the attraction of water molecules to _____ is stronger than their attraction to _____. (The strength of this attraction is due to the ability of water to form _____.)	one another; air; hydrogen bonds
87. The tendency of a liquid to form droplets which minimize the number of molecules at the surface is called _____.	surface tension
88. The chemical produced by Type II pneumocytes is a surfactant, which is a(n) _____ .	chemical that decreases the surface tension of a liquid
89. The lungs of premature babies or other individuals whose Type II pneumocytes are unable to produce surfactant _____.	collapse
90. _____ is a measure of the stretchability or expandibility of the lungs.	Lung compliance
91. The muscles of inspiration are the _____ and _____.	diaphragm; external intercostals
92. Contraction of the diaphragm causes it to move _____, resulting in a(n) ______ in the size of the thoracic cavity and a(n) _____ in pressure within the lungs.	inferiorly; increase; decrease
93. Contraction of the _____ elevates the ribs and sternum, resulting in an increase in the size of the thoracic cavity and a(n) _____ in pressure within the lungs.	external intercostals; decrease
94. Unless forced, expiration is caused by the _____ of the lung tissue and relaxation of the _____ and _____.	elasticity; diaphragm; intercostal muscles
95. _____ is the decrease in the size of an expanded lung due to the elastic fibers of the lung and the surface tension of the liquid which moistens the alveoli.	Lung recoil
96. Lung recoil is increased by _____ which surround the alveoli.	elastic fibers
97. Lung recoil is increased by the alveolar surface tension due to _____.	water in the alveoli
98. Forced expiration relies on contraction of _____ and muscles of the _____ region.	internal intercostals; abdominal
99. In a healthy individual, as pulmonary ventilation increases, so does _____; this is called _____.	pulmonary blood flow; ventilation-perfusion coupling
100. When describing air pressure relationships in terms of the lungs, a simplification is used to allow comparison of individuals living at two different altitudes: barometric air pressure (P_B) is _____.	assigned a value of 0
101. Intrapulmonary pressure is the pressure in the _____, which rises or falls as inspiration or expiration begins, but which eventually equalizes with atmospheric pressure.	alveoli
102. Intrapleural pressure is the pressure in the _____, which rises and falls during respiration, but is always slightly less than intrapulmonary pressure.	pleural cavity

103. Pulmonary function tests evaluate respiratory function using a(n) _____ to measure respiratory volumes and capacities.	spirometer
104. The _____ is the amount of air inhaled during a normal, relaxed breath. In an average adult, it is about _____ ml.	tidal volume (TV); 500
105. The _____ is the amount of additional air that can be inhaled if, after inhaling, one breathes in as deeply as possible. In an average adult this is ~ _____ times the tidal volume.	inspiratory reserve volume (IRV); 6
106. The _____ is the amount of air that can be forced out of the lungs after one has finished exhaling, and in an average adult is ~ _____ ml.	expiratory reserve volume (ERV); 1200
107. The alveoli never _____, and air there, plus air in the anatomical dead space, remains in the lungs even after maximal, forcible exhalation. This is the _____, and in an average adult is ~ _____ ml.	collapse; residual volume (RV); 1200
108. _____ is the amount of air in the conducting system that is not available for use even after full forced inhalation, and is usually ~ _____ ml in an adult male.	Anatomical dead space; 150
109. The _____ is the maximum amount of air that can fill the lungs.	total lung capacity (TLC)
110. The _____ is the maximum amount of air that can be expelled after fully inhaling.	vital capacity (VC)
111. The _____ is the maximum amount of air that can be inhaled.	inspiratory capacity (IC)
112. The amount of air remaining in the lungs after a normal expiration is called the _____.	functional residual capacity (FRC)
113. The total "_____" refers to the volume of air, in liters, that is inhaled in one minute. It is found by multiplying _____ by the _____.	minute ventilation; tidal volume; ventilation rate OR respiratory rate
114. Since each breath exchanges not only the air in the lungs but also the air in the dead space, the volume of air, in liters, that reaches the alveoli is found by subtracting _____ from _____. This is called _____.	(ventilation rate x dead space); total minute ventilation; alveolar ventilation
115. Air is _____% oxygen and _____ % carbon dioxide. The partial pressure of oxygen is thus much _____ than that of carbon dioxide.	21; 0.04; higher
116. (True or False) Carbon dioxide is much more soluble in blood plasma than oxygen is.	TRUE
117. Since the blood is circulating rapidly, and its exposure to the air in the lungs is brief, the capillary walls and alveolar walls must be _____ in order to decrease the distance the gases must diffuse.	thin
118. The total surface area for all of the lung's alveoli is extremely large, which is essential for _____.	efficient gas exchange
119. The partial pressure of oxygen in the alveoli is always _____ than in the blood.	higher

120. The partial pressure of oxygen in the tissues is always _____ than in the blood.	lower
121. Because oxygen <is/is not> very soluble in plasma, _____% of it must be bound to _____ in order to be carried.	is not; 98; hemoglobin
122. Each molecule of hemoglobin can carry _____ <how many?> molecules of oxygen.	four
123. Hemoglobin that is fully saturated with oxygen is called _____; when no oxygen is bound, it is called _____.	oxyhemoglobin; deoxyhemoglobin
124. As the temperature in the blood increases, the binding of oxygen to hemoglobin _____, and thus the delivery of oxygen to tissue _____.	decreases; increases
125. As the partial pressure of carbon dioxide in the blood increases, the binding of oxygen to hemoglobin _____, and thus the delivery of oxygen to tissue _____.	decreases; increases
126. As blood pH decreases, _____ bind to hemoglobin. This causes the binding of oxygen to hemoglobin to _____, and thus the delivery of oxygen to tissue to _____. (This is called the _____.)	hydrogen ions; decrease; increase; Bohr effect
127. Red blood cells produce _____ to control the binding of oxygen to hemoglobin.	2,3-bisphosphoglycerate (2,3-BPG)
128. Levels of _____ in erythrocytes are increased at high altitudes to enhance oxygen delivery to tissues.	2,3-bisphosphoglycerate (2,3-BPG)
129. As levels of 2,3-bisphosphoglycerate in erythrocytes increase, the binding of oxygen to hemoglobin _____, and thus the delivery of oxygen to tissue _____.	decreases; increases
130. With each oxygen molecule that hemoglobin binds, its shape changes to allow it to _____. This allows it to bind oxygen quickly in the lungs, and to release it quickly in oxygen-poor tissues.	bind the next one with higher affinity
131. Most tissues don't need nearly as much oxygen as hemoglobin can carry; however, in _____, including the _____, the partial pressure of oxygen is very low and most of hemoglobin's oxygen is released.	active muscle tissue; heart
132. The partial pressure of carbon dioxide in the alveoli is _____ than in the blood.	slightly lower
133. The partial pressure of carbon dioxide in the tissues is always _____ than in the blood.	higher
134. 70% of the carbon dioxide in the blood is transported as _____; conversion of carbon dioxide to this chemical dramatically increases the rate at which carbon dioxide can be removed from tissue and transported to the lungs.	bicarbonate ions
135. 20% of the carbon dioxide in the blood is transported by _____; 10% or so is found _____.	hemoglobin; in the blood plasma
136. _____ refers to an elevation in carbon dioxide levels in the blood.	Hypercapnia

137. As the oxygen saturation of hemoglobin _____, its ability to carry carbon dioxide _____. This is known as the _____.	decreases; increases; Haldane effect
138. The reaction that forms carbonic acid is: _____.	$CO_2 + H_2O \dashrightarrow H_2CO_3$
139. Carbonic acid dissociates to form _____ and _____. This reaction is _____.	hydrogen ions OR H^+; bicarbonate OR HCO_3^-; reversible
140. Much of the bicarbonate in the body is produced by _____.	erythrocytes
141. Formation of carbonic acid in an aqueous solution is spontaneous but slow. In erythrocytes, where it must occur quickly, it is _____.	catalyzed by an enzyme
142. The carbonic acid/bicarbonate interconversion is _____, and this allows bicarbonate to act as a(n) _____ in the bloodstream. Indeed, it is the most important one!	reversible; buffer
143. As negative bicarbonate ions leave erythrocytes, negative _____ ions enter to maintain the electrical neutrality of the cell. This is called the _____.	chloride; chloride shift
144. Normal, quiet breathing, at a typical ventilation rate, is called _____.	eupnea
145. Difficult or labored respiration is called _____.	dyspnea
146. Absence of breathing is called _____.	apnea
147. Deep, vigorous respiration, common during exercise, is called _____.	hyperpnea
148. The _____ center, located in the medulla, contains two groups of neurons which control respiration: the _____ and the _____ groups.	medullary respiratory; dorsal respiratory; ventral respiratory
149. The dorsal respiratory group, located in the _____, generates _____ which stimulate contraction of the _____.	medulla; rhythmic nerve impulses; diaphragm
150. Although unproven, current thinking holds that nerve impulses from the _____ group not only instigate inspiration but also lead to its time-delayed inhibition.	dorsal respiratory
151. The ventral respiratory group, located in the _____, is required during forceful breathing to recruit the _____.	medulla; intercostal and abdominal muscles
152. The pontine respiratory group, located in the _____, is thought to _____ and prevent _____ by inhibiting the medullary respiration centers.	pons; modify the breathing rhythm; overinflation of the lungs
153. When the chemoreceptors in the _____, _____ and _____ sense an increase in levels of carbon dioxide in the blood, they signal the respiratory control center to _____ the breathing rate.	medulla oblongata; carotid arteries; aorta; increase

154. When the chemoreceptors in the _____, _____ and _____ sense a decrease in the pH of the blood, they signal the respiratory control center to _____ the breathing rate.	medulla oblongata; carotid arteries; aorta; increase
155. When the chemoreceptors in the _____, _____ and _____ sense an increase in levels of hydrogen ions in the blood, they signal the respiratory control center to _____ the breathing rate.	medulla oblongata; carotid arteries; aorta; increase
156. Of the three major chemoreceptor clusters, detection of _____ by the _____ exerts the most control on breathing rate.	carbon dioxide; medulla oblongata
157. When the chemoreceptors in the _____ and _____ sense a decrease in levels of oxygen in the blood, they signal the respiratory control center to _____ the breathing rate.	carotid arteries; aorta; increase
158. When stretch receptors in the walls of the bronchi and bronchioles are _____, inspiration is discontinued in a reflex called the _____ or _____.	fully stretched; Hering-Breuer reflex; inflation reflex
159. Pulmonary irritant reflexes respond to irritation of the respiratory tract by causing _____, followed by increased _____ and _____ through the irritated passageway. Examples include coughing and sneezing.	reflex constriction of the glottis; pulmonary pressure; explosive release
160. The cerebral cortex can exert voluntary control over respiration by bypassing the medullary centers and _____.	directly stimulating the respiratory muscles
161. Sympathetic centers in the _____ modify the ventilation rate and depth in response to strong emotions, abrupt temperature changes, and pain.	hypothalamus
162. Anaerobic exercises causes a dramatic increase in ventilation rate due to the production of _____, which lowers _____. Indeed, respiration is so rapid that carbon dioxide levels may be _____, and oxygen levels _____, than their resting levels.	lactic acid; blood pH; lower; higher
163. Aerobic exercise alters breathing rate within seconds, in part due to direct communication between _____ and the _____.	motor pathways; medullary respiratory center
164. Aerobic exercise alters breathing rate within seconds, in part due to signals sent from _____ to the _____, informing it of the body's exertion.	proprioceptors in the body; medullary respiratory center
165. After the initial rapid increase in ventilation rate, aerobic exercise causes a slow, sustained increase. 'How' remains unknown, but it is NOT due to changes in average _____, nor to changes in _____ or _____ concentrations, which remain constant.	blood pH; oxygen; carbon dioxide
166. Adaptations to high altitudes include an increase in _____, elevated _____, and increased production of erythropoietin (and thus of _____).	ventilation rate; 2,3-BPG; RBCs
167. "COPD" refers to a group of diseases that result in chronic and progressive dyspnea, often accompanied by coughing, frequent pulmonary infections, and respiratory failure. The acronym means, '_____.'	chronic obstructive pulmonary diseases
168. Obstructive emphysema is a COPD which is characterized by _____ and _____.	permanently enlarged alveoli; deterioration of alveolar walls
169. Chronic bronchitis is a COPD which results in _____, as well as inflammation and fibrosis of the _____.	excessive mucus production; lower respiratory mucosa
170. Although asthma is a chronic disease, it is not classified as a “COPD” because the symptoms are not chronic. Asthma is characterized by acute attacks of coughing, dyspnea, wheezing, and chest tightness, brought on by _____.	acute inflammation of the airways

171. _____ is an infectious disease caused by the bacterium Mycobacterium tuberculosis and spread by coughing and inhalation.	Tuberculosis (TB)
172. Until the 1930s, one third of the deaths in the 20-45 year old age group were due to _____. Antibiotics changed that, but the use of these drugs in ways which allowed one or more bacteria to survive has led to the evolution of _____.	tuberculosis (TB); antibiotic resistant strains
173. As of the year 2000, one third of all cancer deaths are due to _____: only one in ten affected individuals is a non-smoker, highlighting the contribution of smoking to the development of the disease.	lung cancer
174. One of _____ types of lung cancer, squamous cell carcinoma arises in the _____, and tends to form masses that hollow out and bleed.	three; epithelium of the bronchi
175. One of _____ types of lung cancer, adenocarcinoma originates in _____ as nodules that develop from _____ and _____.	three; peripheral lung areas; bronchial glands; alveolar cells
176. One of _____ types of lung cancer, small cell carcinoma contains _____ cells that form clusters within the _____ and rapidly metastasize.	three; lymphocyte-like; mediastinum
177. As we age, the thoracic wall becomes _____, the lungs lose _____, and the amount of oxygen we can use during aerobic respiration decreases. These changes are accelerated markedly in _____ individuals.	more rigid; elasticity; inactive
178. The protection provided by mucus declines with age due to alterations in _____, and a decline in the _____ of epithelial cells in the respiratory tract.	mucous glands; ciliary action

1. The digestive system organs fall into two major groups: the _____ and the _____.	gastrointestinal (GI) tract; accessory organs
2. The gastrointestinal tract is sometimes called the _____.	alimentary canal.
3. The gastrointestinal (GI) tract is a(n) _____ tube that twists its way from the mouth to the anus. Chemically inert objects can travel in one end and out the other without change, and are technically never inside the body.	continuous
4. The organs of the gastrointestinal tract, taken in order, begins with the mouth, includes the _____, _____, _____, _____ and _____, and ends with the anus.	pharynx; esophagus; stomach; small intestine; large intestine
5. The accessory digestive organs modify ingested food either _____ or _____, or both.	mechanically; chemically
6. The accessory digestive organs include the _____, _____, _____, _____, _____ and _____.	teeth; tongue; gallbladder; salivary glands; liver; pancreas
7. The central area of the gastrointestinal tract is called the _____, a name that describes this region in many other tubular organs as well.	lumen
8. The organs of the digestive system which are found in the abdominal cavity, and the cavity itself, are lined by a(n) _____ membrane: the _____.	serous; peritoneum
9. The peritoneal cavity is located between the visceral and parietal layers of the peritoneum and is filled with _____.	serous fluid
10. The _____ are double-layered extensions of the peritoneum which connect the abdominal organs to the abdominal walls. Collectively, these extensions are called the _____.	mesenteries; mesentery
11. Several organs lie outside the peritoneal cavity, between the parietal peritoneum and the dorsal abdominal wall. These are referred to as _____ organs.	retroperitoneal
12. The duodenum, pancreas, ascending colon, descending colon, rectum, kidneys, adrenal glands, and urinary bladder are all _____ organs.	retroperitoneal
13. The _____ contains blood vessels, lymphatics, and nerves which supply the digestive organs.	mesentery
14. The _____ holds the abdominal organs in place and prevents them from shifting within the abdominal cavity. In addition, fat accumulates within its folds.	mesentery
15. The most visible mesentery (upon dissection) is the folded layer which hangs like a curtain from the stomach and transverse colon; it is called the _____.	greater omentum
16. Fat accumulates between the folds of the _____, leading to its alternate name: the 'fatty apron.'	greater omentum
17. The oral cavity is divided into two regions: the _____ lies outside of the boundary formed by the teeth (or gums, aka _____) but inside of the mouth; the _____ lies inside of the boundary formed by the teeth (or gums).	vestibule; gingiva; oral cavity proper

18. The posterior of the oral cavity leads into the _____.	pharynx
19. The Latin word for lip is _____ (plural, _____).	labium; labia
20. The roof of the oral cavity is divided into two parts: the bony _____ and the _____.	hard palate; soft palate
21. The _____ is the 'dangly bit' that projects from the soft palate; together with the soft palate, it prevents _____ as one swallows.	uvula; food from entering the nose
22. The opening to the pharynx, aka the _____, is bounded laterally by the _____ of the lymphatic system.	fauces; tonsils
23. The intrinsic muscles of the tongue allow it to change _____, while the extrinsic muscles change its _____.	shape; position
24. Small bumps on the tongue enhance the tongue's ability to _____. In addition, some house receptors called _____.	grip food; taste buds
25. Children have _____ <how many> teeth, adults (counting wisdom teeth), _____.	20; 32
26. _____ are teeth which cut; _____, teeth which tear; and _____ and _____, teeth which grind.	Incisors; canines; premolars; molars
27. The part of a tooth visible above the gums is the _____; the part below the gums, the _____; and the boundary between the two, the _____.	crown; root; neck
28. The root of a tooth is composed of an outer layer of living tissue called _____, within which lies a cavity called the root canal which contains _____ (connective tissue), _____ and _____.	dentin; pulp; blood vessels; nerves
29. The crown of a tooth is composed of a core of living tissue called _____ surrounded by a layer of nonliving _____, the hardest substance in the body.	dentin; enamel
30. Teeth are held in their sockets by _____; the joints they form with the _____ (the sockets) are called gomphoses.	periodontal ligaments; alveoli
31. _____ <how many?> pairs of large salivary glands and hundreds of microscopic ones produce saliva, which lubricates and moistens the oral cavity.	Three
32. The parotid glands are located _____, and produce _____ (watery) saliva.	posterolateral to the masseter; serous
33. The submandibular glands are salivary glands which are located _____, and produce _____ (watery) saliva.	inferomedial to each side of the mandible; serous
34. The sublingual glands are salivary glands which are located _____ and which produce _____ saliva.	beneath the tongue; mucus-rich

35. For the anatomy of the pharynx, see questions 8-13 of 'The Respiratory System.'	
36. The esophagus is a tube lying anterior to the _____ and posterior to the_____ and _____. It connects the _____ to the _____, and has a(n) _____ at each end to control the entry and exit of food and drink.	vertebrae; larynx; trachea; pharynx; stomach; sphincter
37. The lower esophageal sphincter is also known as the _____.	cardiac sphincter
38. The musculature of the esophagus is unusual in that the upper part is _____, while the lower part (close to the stomach) is _____.	voluntary muscle; smooth muscle
39. The upper opening of the stomach is the _____ or _____ opening; leakage of substances through the opening is prevented by the _____.	gastroesophageal; cardiac; cardiac sphincter
40. One part of the stomach, the _____, is superior to the cardiac sphincter. (Gas sometimes accumulates here, leading to an uncomfortably bloated sensation.)	fundus
41. The stomach's contents leave to enter the small intestine via the _____, and unintentional leakage of substances through the opening is prevented by the _____.	pyloric orifice; pyloric sphincter
42. The interior of the empty stomach is extremely wrinkled: these wrinkles, or folds, are called _____ and allow the stomach to expand and stretch when storing food or drink.	rugae
43. The stomach churns food and mixes it with gastric secretions to form _____, which literally means 'juice.'	chyme
44. The stomach does not digest itself because its lumen is coated heavily with a layer of _____.	neutral to alkaline mucus
45. The lower region of the stomach (the _____ region) contracts against the lower sphincter, which does not fully open, in order to transfer chyme a little bit at a time to the small intestines.	pyloric
46. The small intestine is divided conceptually into three regions. Listed in order as food moves, they are the _____, _____ and _____.	duodenum; jejunum; ileum
47. The 25 cm _____ is the C-shaped portion of the small intestine into which the stomach empties. Its name is derived from the number 12, for '12 inches.'	duodenum
48. The second-longest portion of the small intestine is the _____, measuring 2.5 meters (just over 8 feet) in length. (It quickly becomes clear that the small intestine is named 'small' due to its diameter, not its length.)	jejunum
49. The longest portion of the small intestine is the _____, measuring 3.5 meters (almost 11.5 feet).	ileum
50. The great length of the small intestine is necessary for _____; in addition, its surface is formed into _____, _____ and _____, so that its total surface area is huge - roughly the size of a tennis court!	nutrient absorption; circular folds; villi; microvilli
51. The large intestine is divided into five regions. The _____, _____ and approximately one half of the _____ are found on the right side of the body.	vermiform appendix; cecum; colon

52. The large intestine is divided into five regions. Approximately one half of the _____ is found on the left side of the body; from there, feces reach the _____, their final storage place prior to their exit through the _____.	colon; rectum; anal canal
53. The colon is divided into four regions, the _____ colon on the right side of the body, the _____ colon which crosses from right to left, and the _____ colon and _____ colon on the left side of the body.	ascending; transverse; descending; sigmoid
54. The _____ is a vestigial organ roughly the size of one's index finger, suspended from the cecum.	vermiform appendix
55. The chyme, or bolus, enters the large intestine at the top of the _____, and is allowed to fill it and remain there for awhile to decrease the water content.	cecum
56. Entry of chyme into the large intestine is controlled by the _____, which is found at the juncture of the ileum and large intestine.	ileocecal valve
57. The teniae coli are _____ which run the length of the large intestine. They cause the formation of puckered pouches called _____ along the entire length of the large intestine.	ribbons of smooth muscle; haustra
58. Small, fat-filled pouches are attached to the large intestine here and there along its length: these are called _____.	epiploic appendages
59. The anal canal is a 1.5 cm passageway which conducts feces out of the rectum. It includes two _____; the inner one is involuntary, the outer, voluntary.	sphincters
60. The bulk of the liver is on the _____ side of the body, _____ to the esophagus and vena cava.	right; anterior
61. The lobes of the liver are the _____, _____, _____ and _____ lobes.	left; right; caudate; quadrate
62. The quadrate lobe of the liver is _____ to the caudate lobe. Both lie beneath and between the left and right lobes.	anterior
63. The region on the _____ surface of the liver at which blood vessels, ducts, and nerves enter the organ is known as the _____.	inferior; porta
64. Blood enters the liver via two major vessels, the _____ and _____.	hepatic artery; portal vein
65. Innervation of the liver is enabled by entry of the _____ through the porta.	hepatic nerve plexus
66. Lymphatic vessels and _____ <how many?> hepatic bile ducts leave the liver through the porta. The hepatic ducts merge to form the _____.	two; common hepatic duct
67. Dilute bile is produced by the liver and transferred to the _____, where it is _____ and _____.	gallbladder; concentrated; stored until needed
68. The amount of bile produced daily is determined in part by one's _____ daily intake: thus, a sudden decrease in intake (as on a diet) may result in the _____.	average; accumulation of unused bile

69. Accumulation of unused bile in the gallbladder is dangerous, because as water and electrolytes continue to be removed, _____.	cholesterol may precipitate and form gallstones
70. The gallbladder can store approximately _____ ml (plus or minus 15 ml or so) of concentrated bile.	55
71. Bile leaves the gallbladder via the _____ duct, which merges with the _____ duct to form the _____ duct.	cystic; common hepatic; common bile
72. The gallbladder has three layers: the lumen is lined with _____, which is surrounded by the _____, and that in turn by _____.	mucosa; muscularis; serosa
73. The mucosa of the gallbladder, when empty, is _____ to form _____.	folded; rugae
74. The pancreas is a long, roughly triangular organ nestled in the curve of the _____, lying posterior to the _____.	duodenum; stomach
75. The head of the pancreas lies against the _____, while the tail extends toward (and almost reaches) the _____.	duodenum; spleen
76. The pancreas is essentially two glands in one: that is, it has both _____ and _____ functions.	endocrine; exocrine
77. The _____ are clusters of cells in the pancreas which secrete digestive enzymes.	acini
78. The secretions of the acini are collected in a network of ducts which feeds into the _____, which empties into the _____ via two branches, one small and one large.	pancreatic duct; duodenum
79. The smaller branch of the pancreatic duct enters the duodenum via the _____.	minor duodenal papilla
80. The larger branch of the pancreatic duct joins the _____ to form the _____, which empties into the duodenum via the _____.	common bile duct; hepatopancreatic ampulla; major duodenal papilla

1. _____ means simply 'eating or drinking,' while _____ refers to the process of eliminating _____ (material which is left over after all usable substances have been extracted).	Ingestion; defecation; feces
2. _____ is the breakdown of ingested foods into simple organic molecules.	Digestion
3. _____ refers to the mixing of food and digestive juices into a soft pulp.	Mechanical digestion
4. _____ means 'chewing.' It is one means by which _____ occurs.	Mastication; mechanical digestion
5. Smooth muscles in the gastrointestinal tract are responsible for the _____ of food from mouth to anus via processes called _____ (swallowing) and _____.	propulsion; deglutition; peristalsis
6. _____ consists of a series of progressive, alternating contractions of smooth muscle rings which encircle the intestine. The result is propulsion of a portion of the partially digested food, called a(n) _____, through the intestine.	Peristalsis; bolus
7. Mechanical digestion is continued throughout the gastrointestinal tract via a process called _____, in which the bolus is rhythmically divided into ever-smaller portions by bidirectional, peristalsis-like contractions of smooth muscle.	segmentation
8. _____ of enzymes and corrosive liquids, as well as mucus to lubricate and protect the system itself is the function of specialized cells within the gastrointestinal tract and accessory organs.	Secretion
9. _____ of nutrients is possible because cells of the gastrointestinal tract actively transcytose them into the blood or lymph.	Absorption
10. The epithelial cells of the GI tract are joined by _____ so that nutrient molecules cannot enter the body by passing between cells, but must instead pass through them.	tight junctions
11. During _____, complex molecules are separated and hydrolyzed by enzymes, emulsifiers and corrosive chemicals.	chemical digestion
12. Digestive activity is subject to _____ and _____ controls. These, in turn, are triggered by _____ or _____ stimuli.	nervous; hormonal; chemical; mechanical
13. Neural networks found in the entrails, as a group, are the _____ or _____.	enteric plexus; enteric nervous system (ENS)
14. Neural control is primarily _____, via the _____, with only minor modulation from the CNS.	local; enteric plexus
15. Neural regulation of the digestive system is complex, and involves over 30 _____, each mediating a slightly different response from the cells which receive them as signals.	neurotransmitters
16. Many of the hormones that control digestion are produced by _____. This allows each region of the digestive system to interact with _____, even those some distance away.	cells of the digestive system; all of the others
17. Beginning with the esophagus, the GI tract has four major walls or layers, called _____. From the lumen outward, the first three are the _____, _____, and the _____.	tunics; mucosa; submucosa; muscularis

18. The outermost tunic of the GI tract is called the _____ when it is adjacent to the peritoneal cavity, or the ____ in regions where it is physically continuous with surrounding tissue.	visceral serosa; adventitia
19. The mucosa of the intestinal tract consists of three layers: from the lumen outward, they are the _____, _____ and _____.	mucous epithelium; lamina propria; muscularis mucosae
20. In many regions of the GI tract, the mucous epithelium invaginates, penetrating the _____ to form _____.	lamina propria; glands
21. Blood vessels and lymphatic vessels in the _____ <which sublayer?> of the GI tract's mucosa provide nutrients and oxygen, and remove wastes, from the mucous epithelium.	lamina propria
22. The mucosa-associated lymphoid tissue (MALT) is found in the _____ <which sublayer of the GI tract's mucosa?>. Since it is in the gut, MALT in this region is often called "_____" instead of MALT.	lamina propria; Gut-Associated Lymphoid Tissue (GALT)
23. The purpose of the MALT in the GI tract is to protect it from _____.	bacteria which contaminate food or drink
24. Smooth muscles in the _____ <which sublayer of the GI tract's mucosa?> create transient wrinkles which decrease adherence of substances to the intestinal surface and increase local mixing.	muscularis mucosae
25. Most blood vessels, lymphatic vessels, and nerve fibers of the GI tract are found in the _____ <which tunic of the GI tract?>.	submucosa
26. The inner layer of the muscularis consists of smooth muscle fibers which _____ the lumen, while in the outer layer the fibers are arranged _____.	encircle; longitudinally
27. In the stomach and intestines, peristalsis and segmentation are accomplished by alternating contractions of the inner and outer layers of the _____ <which tunic of the GI tract?>.	muscularis
28. _____ cells in the muscularis control the rate of peristalsis and segmentation.	Pacemaker
29. In certain regions of the GI tract, the muscles of the muscularis act as _____, and are capable of closing to prevent movement of food or liquid through the tract.	sphincters
30. Neurons of the enteric plexus in the submucosa are called the _____ plexus; those in the muscularis lie _____ and are called the _____ plexus.	submucosal; between the muscle layers; myenteric
31. The mouth is kept moist between meals primarily by the _____, which are scattered throughout the oral mucosa.	intrinsic salivary glands OR buccal glands
32. When we ingest food (or even think about it!) signals from the _____ branch of the autonomic nervous system cause the _____ salivary glands to produce saliva.	parasympathetic; extrinsic
33. Damage to _____ can prevent signals from the CNS from reaching the salivary glands and increasing salivation.	cranial nerves VII or IX
34. _____ and _____ respond to taste and pressure, and lead to an increase in salivation that is mediated by the autonomic nervous system.	Chemoreceptors; pressoreceptors

35. The _____ branch of the autonomic nervous system inhibits production of serous (watery) saliva, but not of mucin-rich saliva, so that stress leaves the mouth feeling dry and sticky.	sympathetic
36. Saliva contains amylase to begin _____, chemicals including lysozyme and immunoglobin A to _____, and mucin to _____.	starch digestion; inhibit bacterial growth; lubricate the mouth
37. The two major processes which moisten and soften food in the oral cavity are _____ and _____.	mastication; salivation
38. _____ means 'swallowing.'	Deglutition
39. The voluntary portion of deglutition is the _____ phase, which occurs in the mouth. In this phase, the _____ is used to push the food into the _____.	buccal; tongue; oropharynx
40. The second phase of deglutition, the _____ phase, is involuntary.	pharyngeal
41. During the pharyngeal phase of deglutition, the _____ prevents food from returning to the mouth.	tongue
42. During the pharyngeal phase of deglutition, the _____ and _____ prevent food from entering the nasopharynx.	soft palate; uvula
43. During the pharyngeal phase of deglutition, the _____ prevents food from entering the larynx.	epiglottis
44. Cranial nerves V, IX, X and XI are all involved in the _____. Damage to any of them can make it difficult to swallow.	pharyngeal phase of deglutition
45. Three rings of muscles in the pharynx called the _____ contract one after the other to propel food into the esophagus.	pharyngeal constrictor muscles
46. As food reaches the bottom of the pharynx, the _____ relaxes.	upper esophageal sphincter
47. During the third phase of deglutition, the _____ phase, food is propelled toward the stomach by _____ <what type of muscle motion?>.	esophageal; peristalsis
48. Both the pharyngeal and esophageal stages of deglutition are triggered by _____ and lead to both local and CNS signals.	contact with solids or liquids OR tactile receptors
49. Since the task of the esophagus is simply to transport food, its surface is optimized for resisting friction as food passes by; it consists of _____.	stratified squamous epithelium
50. The surface of the esophagus includes _____ glands, which lubricate the surface.	mucous or esophageal
51. Mixing semi-solid food with liquid to form completely liquid '_____' is one of the major functions of the _____.	chyme; stomach

52. Liquid is secreted into the stomach by _____; their entrances, the _____, appear as pores on the stomach's interior surface.	gastric glands; gastric pits
53. Unlike the esophagus, whose surface is specialized to resist friction, the surface of the stomach is specialized for _____, and consists of _____.	secretion; simple columnar epithelium
54. Gastric secretions and food are mixed in the stomach by muscular contractions called _____. These contractions occur primarily in the _____, the widest part of the pyloric region.	mixing waves; antrum
55. Unlike the muscularis in other regions of the GI tract, that of the stomach has _____.	three layers
56. The stomach adjusts to the ingestion of food or drink by _____ and _____ to accommodate to the new demand for volume.	stretching; relaxing
57. While most digestion occurs in the _____, digestion of _____ begins in the stomach.	small intestine; protein
58. _____ cells in the gastric glands secrete a(n) _____ (an inactive proenzyme) called pepsinogen.	Chief; zymogen
59. Pepsinogen, when it is placed in a(n) _____ environment, is activated to form the enzyme _____. This enzyme hydrolyzes _____.	acidic; pepsin; proteins
60. _____ cells in the gastric glands secrete hydrochloric acid, which _____ the pH in the stomach's lumen.	Parietal or Oxyntic; lowers
61. Hydrochloric acid _____ proteins and nucleic acids in the stomach and converts _____ to its active form, _____.	denatures; pepsinogen; pepsin
62. Most bacteria are unable to survive in the stomach because of the _____.	low pH OR acidity
63. The parietal cells use _____ acid as the source for positive hydrogen ions. This produces the negative _____ ion, which they don't need or use.	carbonic; bicarbonate
64. To get rid of bicarbonate ions, parietal cells secrete it into the blood, exchanging it for the readily available _____.	chloride ions
65. The stomach's secretions must be electrically neutral, and so the secretion of positive hydrogen ions into the lumen is accompanied by the secretion of negative _____.	chloride ions
66. In water, hydrochloric acid is present as two ions: _____ and _____.	hydrogen ions; chloride ions
67. The two major cell types in the stomach produce _____, which is necessary so that the stomach does not _____.	mucus; digest itself
68. The mucus that coats the stomach is thick, heavy, and (just as importantly) _____. This is because the mucus producing cells mix their product with _____.	neutral to alkaline; bicarbonate

69. Very few substances are absorbed in the stomach - most cannot penetrate the _____ layer. Those that can include water, alcohol, and a few drugs.	mucus
70. Vitamin B12 would be destroyed by the stomach's acid if not for _____, a protective glycoprotein secreted by _____. (B12 is critical for DNA replication: the first symptom of deficiency is _____ due to poor cell division.)	intrinsic factor; parietal cells; pernicious anemia
71. _____ is needed not only to protect vitamin B12 from destruction in the stomach, but also to allow it to be absorbed in the intestine. Thus, production of this glycoprotein by the stomach is absolutely critical to survival.	Intrinsic factor
72. Three chemicals together signal the parietal cells to secrete HCl: _____, _____ and _____.	gastrin; histamine; acetylcholine
73. Gastrin is released by enteroendocrine cells in the stomach mucosa in response to _____ or to signals from the _____.	an increase in stomach content; CNS
74. Gastrin has several effects, one of which is to promote _____ in the cells of the stomach: thus, in the long term, a large appetite leads to a large _____. (Do not confuse this with a large store of fat in the abdomen, which may also occur!)	cell division; stomach
75. _____ is released by 'ECL cells' and mast cells in the stomach's lamina propria in response to _____.	Histamine; gastrin
76. Histamine binds to H2 receptors on _____ cells, and is the most potent acid-producing signal molecule. (Blocking these receptors with drugs such as Tagamet virtually abolishes acid production.)	parietal OR oxyntic
77. Regulation of the stomach's secretions and motility occurs in three phases: the _____ phase, _____ phase, and _____ phase.	cephalic; gastric; intestinal OR gastrointestinal
78. The _____ phase of gastric regulation occurs before food (or drink) enters the stomach, and depends on taste, smell, and anticipation.	cephalic
79. During the _____ phase of gastric regulation, signals from the medulla oblongata are conveyed by the _____ nerve to the enteric ganglia.	cephalic; vagus
80. During the gastric phase of gastric regulation, the major signals are _____ and the presence of _____ in the stomach. In addition, over-secretion is prevented by _____ feedback. If pH falls too far, acid production stops.	distention; peptides OR amino acids; negative
81. Two chemicals commonly consumed by students (and teachers, to be fair) also trigger the gastric phase or gastric reflex: _____ and _____.	caffeine; alcohol
82. In the _____ phase, sensations in the stomach are sent to the CNS via the vagus nerve: return signals, via the same nerve, increase _____ and _____.	gastric; gastric secretion; motility
83. In the _____ phase, sensations in the stomach activate _____ cells: these release gastrin and other hormones into the blood, which eventually trigger an increase in _____.	gastric; enteroendocrine; gastric secretion and motility
84. Mixing waves occur in the stomach three times per minute: less frequently, stronger _____ waves overwhelm the partially closed _____ sphincter and send a small amount of _____ into the duodenum.	peristaltic; pyloric; liquid
85. In the gastrointestinal or intestinal phase of gastric regulation, the _____ inhibits the activities of the stomach in order to give itself time to cope with _____, _____ or _____.	duodenum; decreases in pH; high levels of fat; over-filling

86. _____ is secreted by the duodenum in response to acid. It travels through the blood to the _____ and _____ cells of the stomach, which it inhibits.	Secretin; parietal OR oxyntic; chief
87. _____ and _____ are secreted by the duodenum in response to the presence of fat: among other activities, these hormones inhibit the activity of the _____.	Gastric inhibitory peptide; cholecystokinin; stomach
88. The duodenum signals the medulla oblongata when conditions are such that a further influx from the stomach would overwhelm it, and the medulla then signals the stomach to decrease gastric activity: this is the _____.	enterogastric reflex
89. A major change in the epithelia occurs between the stomach and duodenum. While the stomach is designed to protect itself and avoid self-digestion, the duodenum is specialized for _____ and _____, and its epithelia includes many _____.	digestion; absorption; villi
90. The _____ cells of the duodenum are covered with _____, which increase their surface area and allow them to absorb more nutrients than would otherwise be possible.	absorptive; microvilli
91. A(n) _____ and a(n) _____ are located in the core of each villus in the small intestine.	capillary bed; lacteal
92. Microvilli have enzymes on their surfaces which _____.	digest carbohydrates and proteins
93. In addition to many absorptive cells, villi also contain _____ cells which secrete mucus, and _____ cells which secrete hormones. The number of these cells _____ as one moves from the jejunum to the ileum to the large intestine.	goblet; enteroendocrine; increases
94. In addition to other cell types, villi also contain immune cells called _____.	intraepithelial lymphocytes
95. In between the villi of the small intestine the mucosa forms _____ which secrete a watery mucus called intestinal juice.	intestinal crypts OR crypts of Lieberkuhn
96. The villus epithelium is replaced every _____.	3 to 6 days
97. As one moves from the duodenum toward the ileum, patches of lymphoid tissue called _____ become more abundant.	Peyer's patches
98. A highly alkaline mucus which helps to neutralize the acidic chyme exiting the stomach is produced by _____ in the _____.	duodenal glands OR Brunner's glands; duodenum
99. Two accessory digestive organs, the _____ and _____, deliver their products directly to the duodenum.	liver; pancreas
100. Two openings are found in the duodenum through which digestive juices enter: the opening of the _____ and the large, nipple-like opening formed by the union of several ducts, the _____.	accessory (pancreatic) duct; hepatopancreatic ampulla
101. Entry of bile and pancreatic juice through the hepatopancreatic ampulla is controlled by the _____. The bulge formed by this, and the hepatopancreatic ampulla, is called the _____.	hepatopancreatic sphincter OR sphincter of Oddi; major duodenal papilla
102. The major histological differences seen as one progresses through the small intestine is that the _____ decrease in number and density while the _____ increase.	villi; Peyer's patches

103. Most of the small intestine is covered by the visceral peritoneum; the duodenum, however, is _____ and so its outer layer is _____.	retroperitoneal; adventitia
104. _____ or _____ leads to the production of extra intestinal juice by the intestinal crypts.	Distension; exposure to hypertonic or acidic chyme
105. The liver is an organ from which _____ flow, and to which many _____ flow.	digestive juices; absorbed nutrients
106. To suspend tiny droplets of one substance in another (for example, tiny droplets of oil in water) is to _____ it.	emulsify
107. _____ is the digestive juice that is produced by the liver, and which functions to emulsify _____.	Bile; fats OR lipids
108. The liver is composed of microscopic structural units called _____.	liver lobules
109. Each liver lobule has roughly _____ sides consisting of adjacent plates, or layers, of liver cells called _____.	six; hepatocytes
110. At each corner in a liver lobule is a(n) _____, so named because it contains three structures: a(n) _____, a(n) _____ and a(n) _____.	portal triad; hepatic artery; portal vein; bile duct
111. Between each layer of hepatocytes in a liver lobule lies a space called a(n) _____, which is a large, leaky capillary.	sinusoid
112. Within the liver sinusoids, blood from the _____ and _____ mix before they reach the central vein.	hepatic artery; portal vein
113. Blood in the _____ of the liver lobules eventually enters the hepatic veins, then leaves the liver to flow to the inferior vena cava.	central veins
114. _____ <which type of cells?> are included in the sinusoid walls; their job is to eat debris, bacteria and worn out blood cells.	Hepatic macrophages OR Kupffer cells
115. Nutrients and waste products are altered or removed from the blood in _____ <which cells?> in the liver.	hepatocytes
116. Blood-borne chemicals are modified for disposal by _____ in the liver; the modified chemicals are then either _____ or _____.	hepatocytes; released into the blood for disposal by the kidneys; secreted in bile
117. _____ in the liver are the cells in which _____ is stored, for use as an energy source during brief fasts.	Hepatocytes; glycogen
118. In the absence of insulin, _____ will use lipids to produce _____, an alternate fuel source usable by many tissues in the body, including the brain.	hepatocytes; ketone bodies
119. During periods of extreme hypernutrition (over-eating), _____ in the liver will store lipids. This is also common in alcoholism, since lipid metabolism is inhibited during the metabolism of alcohol.	hepatocytes

120. Once bile is produced by _____, it leaves the liver lobules via the _____.	hepatocytes; bile canaliculi
121. In part because of its role in detoxifying dangerous chemicals and being the first organ which blood leaving the intestines encounters, the _____ is subject to disease. Two of the most common are _____ and _____.	liver; hepatitis; cirrhosis
122. _____ is any disease characterized by inflammation of the liver, and is often caused by viral infections.	Hepatitis
123. _____ is a disease in which normal liver tissue is replaced by connective tissue.	Cirrhosis
124. Detoxified substances and waste products which are removed from the blood by the liver are disposed of in the _____.	bile
125. Bile is a mixture of waste products and '_____,' which are required for fat digestion. They are _____ in the ileum so that they can be recycled.	bile salts; reabsorbed
126. _____ are made from cholesterol and use more cholesterol than any other single bodily function.	Bile salts
127. Fat is emulsified in order to increase the_____ of the droplets.	surface area
128. The major function of the gallbladder is to _____ and _____ bile until it is needed.	store; concentrate
129. Bile backs up into the gallbladder through the _____ due to the fact that the _____ is closed unless digestion is in progress.	cystic duct; hepatopancreatic sphincter
130. Gallbladder contraction and opening of the hepatopancreatic sphincter is controlled by _____, a hormone with several functions.	cholecystokinin (CCK)
131. Cholecystokinin (CCK) is released to the blood by the duodenum in response to the entry of _____.	fat-containing chyme
132. All of the macromolecules depend on _____ for the production of enzymes which lead to their digestion.	the pancreas
133. Microscopic examination of the pancreas reveals the presence of many _____, which are clusters of secretory cells and their associated ducts.	acini
134. One of the major functions of the pancreas is to secrete bicarbonate, which is used to _____ entering the _____.	neutralize acidic chyme; duodenum
135. Many enzymes produced by the pancreas are released as _____.	zymogens OR proenzymes
136. Trypsin is one of the enzymes released by the pancreas. Trypsin _____ many of the other enzymes. (It is released as a zymogen called trypsinogen.)	activates

137. Trypsinogen is converted to trypsin by an enzyme found on the _____. Such enzymes are called _____ enzymes because of the appearance of the microvilli when light microscopy is used.	microvilli; brush border
138. Several pancreatic enzymes, including amylase and lipase, depend for their activity on substances found in the _____.	chyme
139. Two major hormonal controls of pancreatic activity are _____ and _____.	cholecystokinin (CCK); secretin
140. Secretin is released by duodenal cells in response to _____.	acid OR low pH
141. Secretin prompts the pancreas to release _____-rich pancreatic juice.	bicarbonate
142. Cholecystokinin is released by duodenal cells in response to _____ and _____.	proteins; fats
143. Cholecystokinin prompts the pancreas to release _____-rich pancreatic juice.	enzyme
144. The CNS can also activate pancreatic secretions via the _____ nerve: this occurs primarily during the _____ and _____ phases of gastric regulation.	vagus; cephalic; gastric
145. Premature activation of pepsinogen, trypsinogen, or any of the digestive enzymes would result in _____.	digestion of the cells that produce them
146. Digestive enzymes are produced primarily by the _____, not by the intestines.	pancreas
147. Within the small intestine, _____ waves are rare while _____ waves are common. As a result, food is slow to pass through the small intestine.	peristaltic; mixing
148. The ileocecal sphincter is normally _____. Two factors can change that: the _____ reflex and the hormone _____.	closed; gastroileal; gastrin
149. The gastroileal reflex is a reflex mediated by the CNS which is caused by activity in the stomach and leads to _____.	increased activity in the ileum
150. Gastrin released by the stomach signals the _____ to relax briefly, thus allowing a bolus of chyme to enter the large intestine.	ileocecal sphincter
151. One of the major functions of the ileocecal sphincter is to prevent _____.	backflow from the large intestine to the small
152. One of the main functions of the large intestine is to absorb _____.	water
153. In order to reduce friction as the rapidly dehydrating feces pass through the large intestine, the surface of the colon contains many deep microscopic indentations called _____, which contain a large number of mucus producing _____.	crypts OR crypts of Lieberkuhn OR intestinal glands; goblet cells

154. The surface epithelium of the anal canal is _____ <what type of tissue?>.	stratified squamous epithelium
155. Bacteria which survive the digestion process multiply in the _____ and _____. Bacteria account for over one quarter of the dry weight of the feces.	ileum and large intestine
156. Most bacteria in a healthy person's intestines are _____; they prevent the growth of _____ and produce several vitamins, including vitamin _____, which is necessary for normal blood clotting.	beneficial; pathogenic bacteria; K
157. The large intestine has two major patterns of movement: _____, which are a form of segmentation, and _____, which are powerful waves which send feces toward the rectum at a rapid pace.	haustral contractions; mass movements
158. One stimulus for mass movements of the colon is known as the _____ reflex, and is triggered by gastric filling.	gastrocolic
159. _____ in the diet increases fecal bulk and prevents damage to the walls of the colon caused by small, hard feces formed by over-absorption of water.	Indigestible carbohydrates (fiber)
160. Overly rapid transit of feces through the large intestine does not allow time for water resorption; the result is _____.	diarrhea
161. Most intestinal gas (_____) is produced as a result of _____ of undigested macromolecules by _____ in the large intestine. (The amount produced depends on their identity and nature.)	flatus; fermentation; bacteria
162. Digestion of macromolecules involves their _____ into smaller molecules.	hydrolysis
163. Carbohydrate digestion begins in the _____ with the enzyme _____.	mouth; amylase
164. Carbohydrate digestion slows in the _____, then is accelerated again in the _____, where carbohydrates are exposed to _____.	stomach; duodenum; pancreatic amylase
165. Once carbohydrates have been broken down into disaccharides, the final hydrolysis to yield monomers is catalyzed by enzymes found _____.	on the microvilli OR on the brush border
166. Absorption of monosaccharides occurs in _____, but primarily in the _____ and _____.	the entire small intestine; duodenum; jejunum
167. Once absorbed, monosaccharides are transported in the _____ to the _____.	blood; liver
168. Digestible carbohydrates in the human diet consist of _____, some _____ and two polysaccharides: _____ and _____.	monosaccharides; disaccharides; glycogen; starch
169. We lack enzymes to digest some carbohydrates (for example, cellulose) and so if eaten, these reach the _____ undigested. They are referred to as _____.	large intestine; fiber
170. The first enzyme to hydrolyze proteins into smaller parts is _____, in the _____. This enzyme is inactivated when it reaches the _____.	pepsin; stomach; duodenum

171. Partially digested proteins are exposed to several free-floating proteases in the _____; these are produced by the _____.	duodenum; pancreas
172. Polypeptides are hydrolyzed to single amino acids by _____, or in the case of some dipeptides or tripeptides, by _____ of the intestinal epithelial cells.	brush border enzymes; intracellular enzymes
173. Amino acids are absorbed by the _____ in the cells of the _____, then transported in the _____ to the _____.	microvilli; small intestine; blood; liver
174. Dietary fat is usually in the form of _____.	triglycerides
175. For the most part, digestion of fat begins in the _____, with their _____ by bile. (A very small amount of fat digestion occurs prior to this point.)	duodenum; emulsification
176. Fat-digesting enzymes called _____ are released by the _____.	lipases; pancreas
177. Lipases in the small intestine hydrolyze triglycerides to form _____ and _____. These combine with a component of bile salts to form microscopic _____ in a process similar to emulsification of the original fats.	monoglycerides; fatty acids; micelles
178. Micelles containing monoglycerides, fatty acids, and cholesterol (another lipid) are absorbed by the epithelial cells of the _____.	small intestine
179. In the epithelial cells of the small intestine, monoglycerides and fatty acids are used to re-make the triglycerides. These, and cholesterol, are coated with _____ to form structures called _____.	protein; chylomicrons
180. Chylomicrons are exported into the _____ of the lamina propria where they enter _____, which deliver them to the blood vessels of the neck in the lymph.	interstitial fluid; lacteals
181. Digestion of nucleic acids begins in the _____, where they encounter _____ secreted by the _____.	duodenum; nucleases; pancreas
182. Each nucleotide released from nucleic acids is broken down to a(n) _____, a(n) _____ and a(n) _____ by _____.	sugar; base; phosphate ion; brush border enzymes
183. Many vitamins, minerals, and drugs are not _____.	chemically digested
184. Vitamins, minerals, and drugs which are soluble in water enter through the intestinal epithelial cells and travel to the _____.	liver
185. Vitamins and drugs which are soluble in fat enter through the intestinal epithelial cells along with the fat and travel to the _____ via the _____.	blood vessels of the neck; lymphatic system
186. Nine liters (over two gallons) of water enter the intestines each day from the blood and by ingestion. Active transport of nutrients, ions, minerals, etc., into intestinal cells lowers the _____, and so water enters the cells as well.	relative tonicity of the chyme

1. A(n) _____ is a substance in food that provides energy or material for growth, maintenance, or repair.	nutrient
2. _____ are nutrients, such as protein, that are required in large quantities; _____ are nutrients, such as most vitamins, which are required in very small quantities.	Macronutrients; micronutrients
3. Nutritional science is still young, and new _____, as well as new information about old _____, is reported frequently.	nutrients; nutrients
4. The _____ is the average daily nutrient intake meeting the needs of half the healthy individuals in a given life stage and gender group (but insufficient for the other half).	Estimated Average Requirement (EAR)
5. The _____ is the average daily nutrient intake meeting the needs of nearly all healthy individuals in a given life stage and gender group.	Recommended Dietary Allowance (RDA)
6. The _____ is the observed nutrient intake of apparently healthy people and is simply the amount that is assumed to be enough. It is used when an RDA hasn't been determined.	Adequate Intake (AI)
7. The _____ is the highest average daily nutrient intake level that is thought to be safe for almost all individuals in the general population.	Tolerable Upper Intake Level (UL)
8. There are four values commonly used to describe nutrient requirements in humans: EAR, RDA, AI, and UL. As a group, these are referred to as the _____.	Dietary Reference Intakes (DRI)
9. All DRI measures are _____ values. The amount consumed on a(n) _____ may vary without harm.	average; particular day
10. DRI values are established for specific groups based on specific _____ if the nutrient intake is insufficient: examples include normal growth for children, normal milk production in new mothers, weight maintenance in adults, etc.	consequences which will be observed
11. _____ is perhaps the most fundamental macronutrient.	Water
12. _____ is a macronutrient required to build and repair the machinery of the body; it is broken down to its monomer units, amino acids, before it crosses the intestinal wall to enter the body.	Protein
13. _____ is a macronutrient which is used to provide energy, but which can only be stored in limited amounts because it must be dissolved in large volumes of water.	Carbohydrate
14. _____ is a macronutrient which provides large quantities of energy. In its absence, some vitamins cannot enter the body. Some types are used as precursors to cellular molecules and are _____ <hint: cannot be made by the body>.	Fat; essential
15. _____ are micronutrients which are required by various enzymes within the body in order for them to function properly, or which participate in various cellular reactions. They are _____ <hint: carbon based> molecules.	Vitamins; organic
16. _____ are nutrients whose functions include participating in cellular reactions, serving as structural components of the body, serving as electrochemical energy reservoirs, and participating in fluid balance.	Minerals
17. _____ refers to a large group of organic macromolecules produced by plants and which, when eaten, reach the human large intestine undigested. Most are carbohydrates with molecular bonds which _____ by human enzymes.	Fiber; cannot be hydrolyzed

18. _____ has only recently come to be considered a nutrient (and, by some authors, is still placed in a non-nutrient category). Some types are used by symbiotic intestinal bacteria as food, and others are required for normal intestinal function.	Fiber
19. Some nutrients can be made by the human body if they are in short supply: for example, some amino acids can be made by converting others. Such nutrients are called _____.	non-essential
20. Humans lack the enzymatic machinery required to create some nutrients even if provided with raw materials. These nutrients must be present in the diet if one is to survive, and are called _____ nutrients.	essential
21. There are 20 different amino acids encoded in DNA. Virtually all proteins in the human body require _____ of these for their construction.	all 20
22. Eleven of the twenty amino acids can be made by various human tissues from _____ and _____ (which is available from other types of amino acids as well as other sources). Thus, these eleven are _____ in the diet.	glucose; amino nitrogen; non-essential
23. Nine of the twenty amino acids cannot be made by human enzymes, and must be _____. These nine amino acids are _____ in the diet.	eaten; essential
24. Of the essential amino acids, one - _____ - is only essential for infants. (Adults can synthesize it.)	histidine
25. Amino acids are obtained from the various types of _____ which we eat.	protein
26. If one of the _____ <how many?> essential amino acids is absent in a particular cell, protein synthesis will _____.	nine; stop
27. The amount of protein that is required in the diet depends on its content of the _____. Enough protein must be eaten to ensure that _____ is consumed, even if large excesses of the others must be eaten at the same time.	essential amino acids; enough of each one
28. Protein is used as fuel _____, and so dietary protein requirements depend on caloric intake.	during food shortages
29. Protein needs increase when _____.	new tissue must be built
30. _____ refers to the state in which the amount of protein (as measured by amino nitrogen) eaten by an organism is equal to the amount excreted.	Nitrogen balance
31. Proteins which contain all nine essential amino acids in the ratio needed by the human body are referred to as _____ proteins. Those in which one or more of the nine is missing are called _____ proteins.	complete; incomplete
32. Protein in meat, fish, and eggs is _____. Protein derived from plants, however, is often _____ and so combinations of various plant proteins (for example, beans with _____) must be consumed by vegetarians if they hope to remain healthy.	complete; incomplete; rice
33. Most fats in the diet are consumed as _____, which contain a glycerol backbone and three _____.	triglycerides; fatty acids
34. Fatty acids differ from one another in terms of _____, and also in terms of the _____ and _____ of double bonds.	length; number; position

35. The carbons in fatty acids are numbered, for physiological purposes, beginning with the carbon _____. This is used to describe the location of the double bond _____: for example, n-3 means that there is a double bond between carbons 3 and 4.	farthest from the acid group; farthest from the acid group
36. The _____ in a fatty acid is indicated by a number preceding a colon; the number of _____, by a number following a colon. For example, an n-3 18:2 fatty acid has _____ carbons and _____ double bonds. (Don't simply memorize the example!)	number of carbons; double bonds; 18; 2
37. _____ are fatty acids, or fats containing fatty acids, which do not contain any double bonds.	Saturated fats
38. _____ are fatty acids which contain only one double bond.	Monounsaturated fatty acids (MUFAs)
39. _____ are fatty acids which contain several double bonds.	Polyunsaturated fatty acids (PUFAs)
40. _____ are fatty acids which contain one or more double bonds whose hydrogen atoms are across from (trans to) one another in relation to the double bond. Humans have _____ these fats, and they've been associated with a high risk for heart disease.	Trans fats; difficulty metabolizing
41. Humans are unable to create _____ and _____ fatty acids, and so they need to consume them in their diet.	n-3; n-6
42. Other ways of describing the position of double bonds in fatty acids also exist: instead of 'n-3,' one could also write _____ 3, or _____ 3.	omega; ϖ
43. Essential long chain fatty acids have _____ <how many?> carbons; short chains, of course, have fewer.	20-22
44. Long chain n-3 fatty acids are most easily found in _____; both short chain n-3 and n-6 fatty acids are found in several vegetable oils, including _____ and _____ oils, and nuts.	fish; canola; soybean
45. Although cholesterol is a lipid found in animal products which we eat, 85% of the cholesterol in our blood is _____.	made by our own cells
46. Fats in the bloodstream, since they are not soluble in water, do not simply float freely: instead they are bound to proteins and surrounded by polar phospholipids. These fat-protein combinations are called _____.	lipoproteins
47. Since fat is less dense than protein, the more fat there is in a lipoprotein, the less dense it is. Thus, lipoproteins in the blood which are carrying a VERY large amount of lipid are called _____.	very low density lipoproteins (VLDL)
48. Since fat is less dense than protein, the more fat there is in a lipoprotein, the less dense it is. Thus, lipoproteins in the blood which are carrying a large amount of lipid are called _____.	low density lipoproteins (LDL)
49. Since fat is less dense than protein, the more fat there is in a lipoprotein, the less dense it is. Thus, lipoproteins in the blood with few triglycerides and low cholesterol are called _____.	high density lipoproteins (HDL)
50. VLDL and LDL carry phospholipids, triglycerides and cholesterol from the _____ to the _____, where they will be used.	liver; body
51. HDL carries phospholipids, triglycerides and cholesterol from the _____ to the _____ where they will be degraded or recycled. (Cholesterol in this lipoprotein is called '_____.')	body; liver; good cholesterol

52. Both long and short chain n-3 fatty acids lower LDL levels and raise HDL levels, but the long chain versions are effective in _____.	smaller amounts
53. Except for _____ from milk and the very, very small amounts of _____ left in meats after storage, all the carbohydrates we ingest are derived from plants.	lactose; glycogen
54. Simple carbohydrates include _____ and _____.	monosaccharides; disaccharides
55. Complex carbohydrates are polysaccharides: those from plants are _____, and the form we store in our liver and muscles is _____. Both are polymers of _____, but the nature of the bonds differs.	starch; glycogen; glucose
56. A “dietary calorie” is a measure of _____; it represents the amount of _____ needed to raise the temperature of one kilogram of water, one degree Celsius. (If the word dietary is omitted, the “C” should be capitalized to distinguish the word from true calories.)	energy; energy
57. On average, each gram of protein in a food contributes _____ Calories to one's diet.	4
58. On average, each gram of digestible carbohydrate in a food contributes _____ Calories to one's diet.	4
59. On average, each gram of fat in a food contributes _____ Calories to one's diet.	9
60. As of 2006, the FDA permits four different methods for calculating Calories to be used. As a result, on many labels, fiber is treated as if it contributed 4 calories per gram. To estimate the fiber-free caloric value of food, _____.*	multiply protein and DIGESTIBLE carbohydrates by 4 and fat by 9; add them.
61. _____ is the sensation of having eaten enough to be satisfied; it is the opposite of hunger.	Satiety
62. Muscle adds strength, which allows more work to be performed per _____, and thus an increase in muscle mass leads to an increase in Calories burnt during exercise or work.	protein; complex carbohydrates; fiber
63. In general, foods rich in both _____ and _____ lead to delayed satiation. (That is, more Calories will be eaten in a single sitting.)	simple carbohydrates; fat
64. In general, foods containing only _____ lead to rapid satiation, but hunger returns quickly and with greater intensity than was experienced initially.	simple carbohydrates
65. In general, fat is not palatable by itself and is combined with protein or carbohydrates. In such combinations, the _____ controls the onset of satiation, whereas the _____ tends to prolong the duration of satiation.	protein or carbohydrate; fat
66. Vitamins A, D, E, and K are _____, which among other things means that they will not dissolve in _____.	fat-soluble; water
67. Consumption of fat soluble vitamins without any accompanying fat results in _____, since they will not be dissolved.	lack of absorption OR malabsorption

68. Mild overdoses of water-soluble vitamins are _____.	eliminated in the urine
69. Some substances in food, such as avidin in raw eggs (which binds the vitamin biotin), may alter the absorption of vitamins of drugs. For this reason, DRIs for vitamins and minerals are based on _____ and would have to be adjusted for exceptions.	typical diets
70. Individuals must be careful in taking supplements, because some substances interact at high levels: for example, copper or iron and _____ react to form locally toxic products.	vitamin C
71. Some vitamins can be taken in excess without harm, but overdoses of fat-soluble vitamins such as _____ may accumulate in adipose tissue, reaching toxic levels.	vitamin A
72. _____ are chemicals which the body can convert into vitamins if needed. They are often safer at high intake levels than the vitamins themselves. An example is _____, the provitamin of vitamin A which is found in carrots and other orange vegetables.	Provitamins; beta-carotene
73. Excess carbohydrate is initially stored in the _____ and _____ as _____: however, each gram stored requires four grams of water. As a result, carbohydrate storage is limited.	liver; muscles; glycogen
74. Carbohydrate stores are rapidly increased or decreased, and it's possible for body weight to fluctuate as much as _____% due to carbohydrate storage (with the accompanying water) in lean individuals.	5 to 10
75. There are many vitamins and minerals required in the diet, most of which are not found in any single food, and as a result _____ is required in the diet.	variety
76. Most vitamins can be obtained from a variety of sources, both animal and plant based; vitamin _____, however, is not produced by plants at all and can only be found in milk, eggs, or meat. (Bacteria are the source used when vitamin pills are made.)	B12
77. The vitamins _____, _____ and _____ are all damaged or lost if the foods they are in are over-cooked. On the other hand, some nutrients (such as _____) are more readily absorbed from cooked food.	folate; thiamin; vitamin C; beta-carotene
78. A rough measure of obesity is the _____, which uses height and weight to calculate a score. Because muscle is much denser than fat, however, it does not work for _____; it works best for _____ with a(n) _____.	body mass index (BMI); athletes; sedentary adults; medium frame
79. For sedentary adults, a BMI of 25 to 30 indicates that the individual is _____; a value greater than 30 means that the person is considered by the World Health Organization to be _____.	overweight; obese
80. For sedentary adults, a BMI greater than 40 indicates that the individual is _____.	morbidly obese
81. For sedentary female adults, a BMI of less than 18 is considered to be _____; for sedentary males, the value is 20.	underweight
82. BMI is used to determine obesity in children by comparison with _____.	other children of the same age and gender
83. In American units, BMI = (703 x weight in pounds) / (height in inches)^2; in international units, BMI = (weight in kg) / (height in meters)^2. Thus, for a 6', 180 lb (1.83 m, 81.6 kg) male, the BMI is _____. (Be able to calculate this for anyone.)	24.4
84. _____ refers to the state in which the energy used by an organism is equal to the energy ingested; none is available for storage, but there is no deficit.	Energy balance

85. The _____ is the average dietary energy intake that is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height, level of physical activity, and biological status (pregnant, nursing, etc.).	estimated energy requirement (EER)
86. EER formulas for various age/sex groups were published in the IOM Dietary Reference Intakes macronutrients report, 2002, and are available (among other places) from _____.	choosemyplate.gov
87. As with DRI values, EER calculations represent a(n) _____, and not the amount consumed _____.	average value; on any particular day
88. For moderately active adults, a rough estimate of EER is used by many athletes: _____ for women, and _____ for men. (Be able to calculate this if given someone's gender and bodyweight.)	14 x bodyweight in pounds; 15 x bodyweight in pounds
89. EER is based on weight maintenance; for moderately active, healthy adults wishing to lose weight, the rough estimates used by most athletes to lose fat without losing muscle is _____. (Be able to calculate this is given someone's bodyweight.)	10 x bodyweight in pounds
90. Individuals intending to lose weight must decrease their _____ intake without decreasing their intake of _____.	energy; essential nutrients
91. In 1992, the USDA released a 'food pyramid' intended to serve as a guide in planning a healthy diet. In 2005, this was replaced by an interactive website, now (2012) known as: _____.	choosemyplate.gov
92. Unlike the 1992 food pyramid, the current version recommends intake based on individual _____ and _____, and provides recommendations in _____ instead of 'servings.'	age; gender; weights or volumes
93. Unlike the 1992 food pyramid, the current version distinguishes between _____ fats and carbohydrates.	types of

1. _____ is the building of complex structures from simpler ones, and requires energy, much of which is supplied by _____.

   Anabolism; ATP

2. _____ is the breakdown of complex structures into simpler ones. Much of the energy released is captured in _____.

   Catabolism; ATP

3. _____ is the entire set of reactions comprising both anabolism and catabolism.

   Metabolism

4. Carbohydrate is stored in the body as _____.

   glycogen

5. _____ is the set of reactions in which the body generates glycogen polymers from glucose.

   Glycogenesis

6. When glucose is needed by the body as fuel, glycogen is hydrolyzed back to glucose in a process called _____.

   glycogenolysis

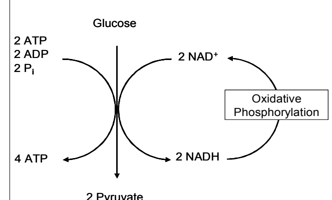
7. In the _____ or _____, both glycogenolysis and gluconeogenesis result in export of glucose into the blood; in _____, however, the glucose that is produced cannot leave the cell.

   liver; kidneys; muscle

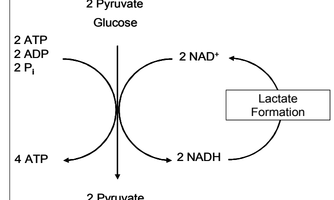
8. Glycolysis occurs in the cell's _____, and captures some of the energy stored in glucose or fructose as ATP. It is particularly useful because it does not require oxygen and is _____.

   cytoplasm; very fast

9. Draw a simple diagram of glycolysis showing NAD+, NADH, glucose, ADP, Pi, ATP, and pyruvate, assuming that oxygen is available.



10. Draw a simple diagram of glycolysis showing NAD+, NADH, glucose, ADP, Pi, ATP, and pyruvate, assuming that oxygen is NOT available.



11. If _____, NADH generated during glycolysis is re-oxidized during "oxidative phosphorylation" and the energy stored in it is _____.

    oxygen is available; used to make ATP

12. If _____, NADH generated during glycolysis is re-oxidized by reducing the product of glycolysis (pyruvate) to lactate and the energy in the NADH is _____.

    oxygen is NOT available; lost

13. Before it can enter the citric acid cycle, pyruvate must be converted to _____. Pyruvate has three carbons: _____ has two. The "missing" carbon leaves as _____, and the energy that is released is captured in _____.

    acetyl-CoA; acetyl-CoA; CO_2; NADH

14. When a phosphate is transferred from a molecule to an ADP, the molecule, phosphate and ADP are _____ in a reaction. The process is called _____.

    substrates; substrate level phosphorylation

15. When a phosphate is added to ADP by the action of ATP synthase, which is driven by a hydrogen ion gradient generated by the _____ of fuels, the process is called _____.

    oxidation; oxidative phosphorylation

16. The citric acid cycle occurs in the _____, and its purpose is to finish oxidizing fuels that were partially oxidized elsewhere in the cell in order to _____.

    mitochondrial matrix; extract as much energy as possible

17. The citric acid cycle is often called the _____ cycle.	Kreb's
18. _____ enters the Kreb’s cycle, and _____ is produced. The energy is captured in _____, a similar molecule called _____, and _____.	Acetyl-CoA; CO_2; NADH; $FADH_2$; ATP
19. The electron transport chain is found in the _____.	inner mitochondrial membrane
20. Electrons are fed into the electron transport chain by _____ and _____. Their energy is transferred to a hydrogen ion gradient, and eventually they, and nearby hydrogen ions, combine with _____ to form _____.	NADH; $FADH_2$; oxygen; water
21. The _____ across the mitochondrial inner membrane is used to power ATP synthase: as _____ flow through the ATP synthase, ATP is made from ADP and Pi.	hydrogen ion gradient; hydrogen ions
22. In the absence of oxygen, _____ ATP molecules can be produced from the oxidation of glucose or other sugars. Most of glucose’s energy is lost to the cell when _____.	only two; lactate is discarded
23. Lactic acid produced by anaerobic glycolysis is transported in the blood to other organs which can convert it back to _____ so that it can be used in oxidative phosphorylation.	pyruvate
24. In the presence of oxygen, up to _____ ATP can be produced, since the glucose can be completely, instead of partially, oxidized. There is no need to discard lactate.	38
25. Fats are stored in the body as _____.	triglycerides
26. The first step in fat catabolism is lipolysis, the separation of the _____ and _____ within the triglycerides.	fatty acids; glycerol
27. _____ is a three carbon molecule which can be converted to a glycolytic intermediate; after release by lipolysis it can be used in _____ to form pyruvate or, in the liver, to build _____.	Glycerol; glycolysis; glucose
28. Within a cell's _____, fatty acids undergo beta-oxidation, a process in which _____.	mitochondria; carbons are removed two at a time to form acetyl-CoA
29. In most tissues, acetyl-CoA formed by oxidation of fatty acids is used in _____.	the citric acid cycle
30. In the liver, pyruvate can be produced from _____ or from _____ as well as from glucose.	amino acids; lactate
31. In the liver, pyruvate can be oxidized as fuel in the TCA cycle, or can be _____.	used to make glucose in a process called gluconeogenesis
32. If the liver does not have enough raw materials to make much pyruvate, both gluconeogenesis and the TCA cycle slow down, and levels of _____ increase.	acetyl-CoA from fatty acid oxidation
33. If the liver has more acetyl-CoA (from fatty acid oxidation) than it does pyruvate, it uses the extra to make "_____" which the liver secretes into the blood. From there they reach the many tissues of the body, including the brain, that can _____.	ketone bodies; use them as fuel
34. After a(n) _____, blood levels of 'ketone bodies' are ~ 0.12 mM.	overnight fast

35. After a(n) _____, blood levels of 'ketone bodies' are ~ 7 mM.	two week fast
36. In _____, blood levels of 'ketone bodies' are often ~ 23 mM.	diabetic ketoacidosis
37. The production of 'ketone bodies' is _____ in healthy individuals even during a fast, and levels are not allowed to increase enough to _____.	tightly regulated; alter the blood's pH
38. In diabetic ketoacidosis, production of 'ketone bodies' is _____ and blood pH _____. This leads to coma and death, unless _____ is administered.	uncontrolled; falls; insulin
39. Proteins which are no longer needed are _____, and these in turn are catabolized.	hydrolyzed to amino acids
40. When an amino acid is to be catabolized, the amino groups are converted to _____ and then to _____ in the liver.	ammonia; urea
41. When an amino acid is to be catabolized, after removal of the amino group, the remaining "keto acid" is altered to allow it to enter the _____ (the point of entry depends on the identity of the amino acid).	citric acid cycle
42. What the body cannot store, it must metabolize, either using it for energy or converting it to a storable form. Alcohol, for example, cannot be stored. Such nutrients are called '_____.'	obligate fuels
43. Alcohol cannot be stored, and an alcoholic drink with a meal results in temporary _____ as the alcohol is used.	storage of the macronutrients ingested in the meal
44. Protein that is not needed for repair or growth is **generally** _____ or _____.	used for energy; converted to carbohydrates or fat
45. In times of rapid weight gain excess protein is stored as extra muscle, but this process is so energetically demanding that it occurs only in the presence of _____ and is usually accompanied by a large fat deposition.	very high caloric intakes
46. Adaptations to increased or decreased ratios of fat to carbohydrate occur _____<how fast?>.	within days
47. Adaptations to changes in protein intake occurs after _____<how soon?>, and an abrupt decrease in dietary protein from accustomed levels can lead to a negative nitrogen balance as required amino acids are _____.	weeks; catabolized for fuel
48. _____ is the most easily stored macronutrient, and excess Calories will result in _____ from the extra food being preferentially stored.	Fat; fats
49. The major macronutrients and many of their constituents (the non-essential amino acids, and many types of fatty acids) can be enzymatically altered to _____.	convert one to another
50. Most (although not all) nutrient inter-conversions occur in the _____, and this is one of its primary tasks.	liver
51. Because of the amount of water needed to solubilize it, glycogen occupies a great deal of space and is quite heavy per Calorie stored. Thus, only _____ <enough for how long?> can be stored.	a few days' worth
52. Once glycogen stores are full, excess carbohydrate is converted into a(n) _____ in a process called _____.	16 carbon saturated fat; lipogenesis

53. As glycogen stores are depleted, or when protein intake is excessive, the liver, kidney, and muscles use amino acids, lactic acid, or glycerol from fats to build new glucose from in a process called _____.	gluconeogenesis.
54. For several hours after eating, the body is in an _____ state, during which its needs for energy and raw materials for anabolic processes are met by _____.	absorptive; nutrients being absorbed by the intestines
55. Once the intestines are empty the body enters the _____ state.	post-absorptive
56. During the post-absorptive state, energy needs are met by _____.	drawing on stored fuels
57. During the post-absorptive state, raw materials for anabolic processes are obtained by _____: that is, existing molecules are catabolized and their component parts used to build new molecules that may be needed.	recycling existing molecules
58. _____ is the energy used at rest. In a typical individual, it is a bit more than half of our daily energy usage.	Basal metabolic rate
59. _____ is the basal metabolic rate, plus any energy used to _____ or _____. (The need to burn energy to digest food is called the thermic effect of food.)	Total metabolic rate; digest food; perform work
60. Muscle tissue, even at rest, is metabolically expensive: the greater its mass, the higher the _____.	basal metabolic rate
61. Muscle adds strength, which allows more work to be performed per _____, and thus an increase in muscle mass leads to an increase in calories burnt during exercise or work.	hour OR minute
62. Metabolic processes generate heat as a(n) _____. This is the source of our body's warmth.	waste product
63. A precise body temperature is maintained by adjusting _____, _____, _____, and _____. These events are overseen and controlled by the _____.	BMR; surface blood flow; sweat production; muscle tension (shivering); hypothalamus
64. Basal metabolic rate is largely controlled by the _____, which among other things alter the amount of "wasteful" ion transport across cellular membranes.	thyroid hormones

1. Although a great deal of waste material is discarded by the intestines, most was never truly within the body. Almost all of the waste products originating from within the body itself are removed and discarded by the _____.	kidneys
2. The kidneys play a major role in _____ by sorting useful and necessary molecules from those that are toxic or unneeded.	waste removal
3. Urine is usually _____ but the pH can vary from ~4.5 to ~8.0 in response to changes in metabolism or diet.	slightly acidic
4. Urine composition is complex, but includes ions, _____ from catabolism of amino acids, _____ from catabolism of dietary nucleic acids and RNA, _____ from decomposition of creatine in the muscles and the yellow _____ from heme breakdown.	urea; urate OR uric acid; creatinine; urobilins OR urochrome
5. Excessive plasma concentrations of organic molecules (such as glucose) can overwhelm the kidney's transport proteins and result in _____.	the presence of organic molecules in the urine
6. Damage to the structures of the urinary system from injury or infection can result in the presence of _____, _____ or _____ in the urine.	large molecules; formed elements; cells
7. In a healthy individual, urine is a(n) _____ liquid until it leaves the body, at which time bacteria present on the external genitalia may contaminate it.	sterile
8. Kidneys regulate blood _____ and _____ by altering the concentration of the urine (and thus, the amount of water lost or conserved) and by releasing _____.	volume; pressure; renin
9. By changing the amount of each ion which is conserved or discarded, the kidneys indirectly regulate the concentrations of solutes in the _____.	blood OR body
10. By alternating between direct disposal of urea and disposal of ammonia, and also by selectively secreting hydrogen or bicarbonate ions, the kidneys have a major influence on the body's _____.	pH
11. By monitoring their own oxygen supply and responding (if low) by releasing _____, a hormone, the kidneys regulate _____.	erythropoietin; red blood cell synthesis
12. The kidneys help to control bone density by regulating the disposal of, or conservation of, _____ in response to _____.	calcium; parathyroid hormone
13. The kidneys help to control calcium absorption by regulating the conversion of vitamin D to _____, which is done in response to _____.	its active form; parathyroid hormone
14. Urine is formed by each of two _____. From each, a muscular tube called the _____ propels urine to the _____ where it is stored until its release is convenient, at which time it flows out of the body through the _____.	kidneys; ureter; bladder; urethra
15. The kidneys are _____ to the peritoneum. Each lies in the _____ region, anterior to the _____, but the right is slightly lower than the left to make room for the _____.	posterior; upper lumbar; 12th rib; liver
16. The kidneys are encased in a fibrous layer of connective tissue called the _____.	renal capsule
17. The kidneys are surrounded by an outer fibrous layer called the _____ which _____. This layer surrounds the adrenal glands as well.	renal fascia; fastens the kidney to surrounding structures

18. A dense layer of adipose tissue called the _____ lies between the renal capsule and the renal fascia. Its function is to _____ and _____ the kidneys.	adipose capsule; support; cushion
19. The medial surface is concave and has a(n) _____, where the ureters, blood vessels, nerves, and lymphatics enter or leave the kidney.	hilus OR hilum
20. The hilus is continuous with the _____, a much deeper indentation filled with fat which cushions the structures which enter and leave the kidney.	renal sinus
21. The outer layer of the kidney, just deep to the renal capsule, is the _____. Columns of tissue from this region called _____ extend toward the hilus; it is within these columns that those renal blood vessels having the largest diameter lie.	renal cortex; renal columns
22. The renal cortex surrounds the _____; columns of cortical tissue extend toward the hilus, separating it into distinct regions called _____.	medulla; renal pyramids
23. Each renal pyramid and the cortical tissue surrounding it is called a(n) _____. The term '_____' refers to these units.	renal lobe; lobar
24. Each renal pyramid is striated. The striations extend from the hilus toward the cortex and are called _____. (They are actually _____.)	medullary rays; collecting ducts
25. Each renal pyramid projects into a tube within the renal sinus which conducts urine away from the kidney. The projection itself is called the _____; the tube which it enters is called a(n) _____ (the plural is ':_____').	renal papilla; minor calyx; minor calyces
26. Several minor calyces merge to form a(n) _____.	major calyx
27. Each kidney contains roughly _____ minor calyces and _____ major calyces.	10-20; 2-3
28. The major calyces in each kidney merge to form a funnel-like chamber called the _____, which later narrows to form the _____, which conducts urine to the urinary bladder.	renal pelvis; ureter
29. Blood (1/4 of the blood pumped by the heart, when one is resting) reaches the kidneys via the _____, which branch to form _____ which branch again within the renal sinus to form the _____.	renal arteries; segmental arteries; lobar arteries
30. Most of the blood reaching the kidney flows to the _____, where it will be filtered.	renal cortex
31. Blood flows to the renal cortex through the _____ arteries, then arches around the renal lobes just below the cortex via the _____ arteries. Many small arteries called the _____ arteries arise here: these supply blood to the _____ arterioles and _____.	interlobar; arcuate; interlobular; afferent; glomerulus
32. Blood leaves the glomerulus via the _____, which take it to a second capillary bed, the _____.	efferent arterioles; peritubular capillaries
33. Juxtamedullary nephrons are supplied with a special type of peritubular capillary, the _____, whose long straight vessels travel directly into and out of the renal pyramids.	vasa recta
34. From the peritubular capillaries, blood leaves the kidneys by flowing through veins whose paths and names are identical to those of the _____.	arteries that delivered the blood to the kidney

35. The blood flow within the kidneys is controlled by the _____, which is supplied by fibers of the sympathetic nervous system originating in the least thoracic and first lumbar splanchnic nerves.	renal plexus
36. _____ are the structures within the kidney that actually sort the substances which should be kept or discarded.	Nephrons
37. Each kidney contains _____<how many, roughly?> nephrons.	over a million
38. Each nephron has two major parts: the _____ in the cortex and a thin _____, U-shaped at the center, which extends from the cortex into the medulla and back.	renal corpuscle; tubule
39. There are two types of nephron: the glomerulus of _____ nephrons is near the medulla, and the tubule of these nephrons _____ into a renal pyramid. These nephrons are very important in the production of _____ urine.	juxtamedullary; travels deep; concentrated
40. There are two types of nephron: most are _____ nephrons. Each of these has a glomerulus which is near the outer surface of the cortex, and a short tubule which _____ into a renal pyramid.	cortical; does not extend far
41. The function of the renal corpuscle is to _____ in the first step of urine formation.	filter the blood
42. The renal corpuscle has two parts: the central portion is a tangled ball of capillaries called the _____. This is surrounded by the outer portion, a double-walled, cup-like chamber called the _____.	glomerulus; Bowman's capsule
43. The _____ is the interior of the Bowman's capsule, and is continuous with the _____.	capsular space; proximal tubule
44. The inner wall of the Bowman's capsule is permeable to liquid and is called the _____ layer. Liquid cannot pass, however, through the outer wall, the _____ layer.	visceral; parietal
45. Glomerular capillaries contain many _____ through which liquid can pass.	fenestrations
46. _____ forces liquid to leave the capillaries in the glomerulus, while formed elements and large molecules are left behind. The fluid passes through the visceral layer of the Bowman's capsule to enter the capsular space.	Blood pressure
47. The visceral layer of the Bowman's capsule is formed by specialized cells called _____. Fingerlike extensions of these cells wrap the capillaries of the glomerulus; between these are gaps called _____ which allow liquid to pass into the proximal tubule.	podocytes; filtration slits
48. Between the capillary walls and the visceral layer of the Bowman's capsule is a thin basement membrane through which liquid easily passes. Together, these three structures form the _____.	filtration membrane
49. Blood to the glomerulus is supplied by the _____ and leaves by the _____.	afferent arteriole; efferent arteriole
50. The tubule consists of simple epithelium: the _____ or _____ surface of the epithelial cells contacts the filtrate in the lumen, while the _____ or _____ surface contacts the interstitial fluid surrounding the tubule.	apical; lumenal; basal; basolateral
51. The tubular portion of the nephron is divided into several sections both functionally and conceptually: the portion of the tube closest to the renal corpuscle is the _____. Its primary function is _____.	proximal convoluted tubule (PCT); resorption of solutes and water

52. The tubular portion of the nephron is divided into several sections both functionally and conceptually: the portion of the tube farthest from the renal corpuscle is the _____. Its primary function is resorption of water, but this is varied depending on _____.	distal convoluted tubule (DCT); the body's needs
53. Both the proximal and distal tubules are very _____.	convoluted OR twisted
54. The proximal and distal tubules of the nephron are connected by a hairpin-like loop called the _____, which extends toward or into the renal pyramids. Its primary function is _____	loop of Henle; resorption of water and salt
55. The loop of Henle in _____ nephrons extends deep into the renal medulla.	juxtamedullary
56. The region of the loop of Henle in which fluid is traveling toward the hilus is called the _____; the region where fluid is flowing toward the outer surface of the kidney is the _____.	descending limb; ascending limb
57. Each limb of the loop of Henle has a(n) _____ and a(n) _____ portion.	thick; thin
58. The tubule of the nephron twists in such a way that the beginning of the DCT and the afferent and efferent arterioles contact one another. Cells in this region (the _____) are specialized to sense blood pressure, filtration rate, and oxygen availability.	Juxtaglomerular Apparatus (JGA)
59. The Juxtaglomerular Apparatus (JGA) is a group of specialized cells which sense _____, _____, and _____.	blood pressure; filtration rate; oxygen availability
60. The distal tubules of each nephron merge with _____; each of these carries urine from several nephrons to a(n) _____, where it drains via the _____ into a(n) _____ on its way out of the kidney.	collecting ducts; renal papilla; papillary ducts; minor calyx
61. A(n) _____ is a region within a renal lobe which contains a group of nephrons connected to a common collecting duct.	renal lobule
62. There are three processes involved in urine formation: _____, _____ and _____.	filtration; resorption OR reabsorption; secretion
63. In _____, the liquid components of the blood (including small molecules that are dissolved therein) are separated from the formed elements and large molecules.	filtration
64. In resorption, molecules which are _____ are allowed to remain in the filtrate, while glucose, amino acids, ions, and so on are reclaimed.	toxic, unneeded or unrecognized
65. In the _____ and _____, several substances may be specifically secreted: these include ammonia, hydrogen ions, and some drugs.	proximal convoluted tubule (PCT); distal convoluted tubule (DCT)
66. Blood pressure in the glomerulus is controlled by _____ in the afferent and efferent arterioles so that it is maintained at levels that permit filtration.	smooth muscles
67. Glomerular blood pressure is higher than in other capillaries because the _____ arterioles have a larger diameter than the _____ arterioles.	afferent; efferent
68. The blood pressure in the glomerulus is often referred to as the _____.	glomerular hydrostatic pressure (HPg)

69. The _____ is the sum of all of the forces which influence glomerular filtration rate.	net filtration pressure
70. Fluid leaves the glomerulus due to glomerular hydrostatic pressure (HPg). This is inhibited by two factors: _____ or _____ osmotic pressure, abbreviated _____, and back-pressure due to fluid already in the capsular space (_____, abbreviated _____).	blood colloidal; glomerular; OPg; capsular hydrostatic pressure; HPc
71. The _____ is the sum of all of the various forces influencing movement of fluid in the renal corpuscle during filtration. It is given by the formula: _____. (Note: be able to use the formula if given values!)	net filtration pressure (NFP); HPg – (HPc + OPg)
72. A bit over one liter of blood passes through the kidneys and is filtered each minute: this is the _____.	renal blood flow rate
73. Since not all of the blood's volume is due to plasma, it is useful to calculate the _____, which is the amount of plasma filtered by the kidneys per minute.	plasma flow rate
74. The amount of filtrate formed by the kidneys per minute is the _____, and is usually about a fifth of the plasma flow rate.	glomerular filtration rate (GFR)
75. In a healthy kidney, two factors that affect GFR normally do not change: _____ and _____. (In disease states, these factors may change, however.)	the number of glomeruli; the permeability of the filtration membrane
76. To change the filtration rate, both local and systemic mechanisms are able to change the _____.	glomerular hydrostatic pressure (HPg)
77. A '_____' is one in which the smooth muscles in a blood vessel respond to stretching by contracting, or to a decrease in resistance by relaxing.	myogenic response
78. In response to changes in systemic blood pressure, the afferent and efferent arterioles in the kidney dilate or contract to maintain _____; this is an example of a(n) _____. Note that this only works if the changes in systemic pressure are _____.	glomerular hydrostatic pressure (HPg); myogenic response; small
79. Both flow rate and filtrate concentration (osmolarity) are sensed by cells in the DCT, and signals are sent to the glomerulus in response. This is called _____.	tubuloglomerular feedback
80. When the filtrate flow in the DCT is too high, cells in the juxtaglomerular apparatus called _____ cells secrete a chemical signal which causes the _____, decreasing the GFR.	macula densa; afferent arteriole to constrict
81. When the sodium and chloride concentrations in the DCT are too high, cells in the juxtaglomerular apparatus called _____ cells secrete a chemical signal which causes the _____, allowing more time for ion resorption.	macula densa; afferent arteriole to constrict
82. When the filtrate flow in the DCT is too low or the filtrate is too dilute, cells in the juxtaglomerular apparatus called _____ cells STOP secreting a chemical signal which causes the _____. As a result, GFR increases.	macula densa; afferent arteriole to constrict
83. When the filtrate flow in the DCT is too low or the filtrate is too dilute, cells in the juxtaglomerular apparatus called _____ cells secrete renin, which indirectly causes a(n) _____ in systemic blood pressure.	juxtaglomerular (JG); increase
84. When blood pressure in the afferent and efferent arterioles is insufficient, cells in the juxtaglomerular apparatus called _____ cells secrete renin, which indirectly causes a(n) _____ in systemic blood pressure and indirectly _____.	juxtaglomerular (JG); increase; increases sodium retention

85. Renin hydrolyses angiotensinogen to angiotensin I which is converted to _____ by ACE. This in turn stimulates _____ and also production of _____.	angiotensin II; vasoconstriction; aldosterone
86. Aldosterone, released by the cortex of the _____, _____ blood pressure by causing _____ and thus (by osmosis) _____.	adrenal glands; increases; sodium retention; water retention
87. Angiotensin II increases systemic blood pressure by causing generalized vasoconstriction: however, in the kidney, it affects the _____ arterioles more than the _____ ones, and so GFP _____.	efferent; afferent; increases
88. During periods of intense stress, sympathetic signals to the afferent arterioles override the kidney's autoregulation and _____; thus, filtration is _____.	decrease blood flow to the glomerulus; decreased
89. Renal clearance tests measure the _____ per minute, and are used to diagnose glomerular damage or monitor kidney disease.	volume of plasma from which a solute is removed
90. If a renal clearance test is done using a solute that enters the filtrate but which is neither resorbed nor secreted by the nephron, then the renal clearance rate equals the _____. (_____ is often administered and used for this purpose.)	glomerular filtration rate (GFR); Inulin
91. Most solutes and water are resorbed in the _____.	PCT
92. Most or all of the organic nutrients such as glucose which are present in the filtrate are _____.	resorbed in the PCT
93. Resorption of sodium and potassium is controlled by _____.	aldosterone
94. Resorption of calcium is controlled by _____; it is not unusual, in that the resorption of most minerals is _____.	PTH; hormonally controlled
95. Water resorption is regulated by two hormones, _____ and _____: both of these act only on the _____ and _____.	aldosterone; ADH; DCT; collecting duct
96. Most resorption involves the movement of molecules _____ the tubule cells. This, in turn, almost always requires the presence of _____ in the cell membrane.	through; carrier proteins
97. Under certain conditions, so much of a particular solute may be present in the filtrate that the _____ responsible for its resorption aren't sufficient for the task. In such cases, the concentration in the plasma is said to be above the _____.	carrier proteins; renal threshold
98. _____ join tubule cells to one another and prevent the passage of most substances between cells; however, it is thought that water and a few ions are able to be resorbed by this _____ route.	Tight junctions; paracellular
99. A large volume of water is resorbed in the PCT, simply because the _____ creates enough osmotic pressure to cause the water to follow. (Sodium in particular contributes to this effect.)	transfer of solutes to the interstitial fluid
100. As water is resorbed in the PCT, the concentration of the solutes left behind _____. This in turn makes it easier for them to be resorbed.	increases
101. Water movements out of the proximal tubule and loop of Henle is driven by osmotic pressure and sodium concentrations, and is referred to as _____ because it is not regulated directly.	obligatory water resorption

102. Water resorption in the DCT and collecting duct is hormonally controlled, and is referred to as _____.	facultative water resorption
103. Resorption of most substances in the PCT depends on a large _____ gradient between the filtrate and the tubule cells. This gradient is created by _____ at the basal membrane.	sodium; sodium-potassium ATPases
104. Most substances in the PCT are resorbed using _____: that is, _____ enters the cell along with the substance being resorbed, and in fact provides the driving force.	sodium cotransport; sodium
105. _____ during solute resorption in the PCT directly involves ATP hydrolysis, and is the step performed by the _____. _____ occurs when energy stored in a gradient is used to transport a solute.	Primary active transport; sodium-potassium ATPase; Secondary active transport
106. Solutes that have been resorbed leave the tubule cells via _____ or _____ diffusion.	simple; facilitated
107. Water and solutes that have been resorbed enter the _____ and are carried from the kidney.	peritubular capillaries
108. The concentration of a solution can be increased in either of two ways: _____ can be added or _____ can be removed.	solutes; solvent
109. The major difference between the permeabilities of the descending and ascending loops of Henle is that the descending loop is permeable to _____ but not to _____, while the reverse is true in the ascending loop.	water; NaCl
110. In the descending loop of Henle, the filtrate becomes _____ <more/less> concentrated due to the removal of _____; in the ascending loop, it becomes _____ <more/less> concentrated due to the removal of _____.	more; water; less; NaCl
111. Removal of NaCl from the filtrate in the ascending loop of Henle requires _____.	active transport OR ATP
112. _____ is able to diffuse from the collecting duct into the deep medullary tissue, contributing to the increasing osmotic gradient encountered by filtrate as it moves through the loop.	Urea
113. In the medulla, the interstitial fluid is 4 times more concentrated near the _____ than near the _____. This allows juxtamedullary nephrons to produce urine that is _____.	renal papillae; cortex; very concentrated
114. By transporting the filtrate through a region of _____, the kidney maximizes the movement of water out of the filtrate due to osmosis.	high osmolarity
115. Systems such as the vasa recta which rely on exchange between currents flowing in opposite directions in order to maintain a gradient are called _____.	countercurrent systems
116. Blood enters the renal medulla in the descending branch of the _____, and loses _____ and gains _____ in the process. However, the gradient is not disturbed, because blood is carried out along the same route and these processes _____.	vasa recta; water; salt; reverse
117. Although independent, secretion and resorption are not separated _____ (that is, they occur _____).	chronologically; together
118. The sodium gradient used by the PCT to cotransport solutes during resorption can also be used for _____. In this process, a molecule or ion is secreted. The membrane protein performing the task is referred to as a(n) _____	countertransport; antiporter

119. Some organic acids and bases (including some drugs) are secreted in the _____ and _____. These pathways are not specific, and so secretion of one generally competes with _____.	PCT; DCT; secretion of the others
120. The concentration of nitrogen-containing wastes (ammonium ions, urea and uric acid) in urine is increased by secretion in the _____, _____ and _____.	PCT; DCT; collecting duct
121. In addition to their obvious function (collecting urine), collecting ducts in the kidney also control the concentration of the urine by changing their _____ in response to ADH.	permeability to water
122. When the hypothalamus detects that the osmolarity of the blood is too high, _____ is released from the neurohypophysis to conserve water.	antidiuretic hormone
123. ADH acts on the _____ to increase water permeability: this increases _____ water reabsorption.	DCT and collecting ducts; facultative
124. The heart produces _____, which reduces blood pressure, blood volume, and blood sodium concentration by inhibiting _____ release; it also dilates the afferent arteriole to increase _____ and inhibits sodium resorption in the DCT and collecting duct.	atrial natriuretic peptide or hormone (ANP or ANH); renin; GFR
125. Solutes which exceed the _____ of their carriers (or in the case of some drugs, which are not recognized by any carriers) act as _____.	transport maximum; osmotic diuretics
126. Chemicals (drugs) which increase GFR, decrease water resorption, or increase the osmolarity of the filtrate reaching the collecting duct act as _____.	diuretics
127. Calcium resorption is controlled by _____ hormone; in response to this hormone, calcium resorption in the _____ is increased.	parathyroid; DCT
128. Aldosterone acts on the DCT and collecting duct to increase _____.	sodium resorption
129. Excess potassium is toxic, and so secretion is sometimes necessary: this occurs in the _____ and _____ and is controlled by the hormone _____.	DCT; collecting duct; aldosterone
130. K^+ and H^+ ion secretion in the DCT and collecting ducts uses Na^+ antiporters, and so an increase in Na^+ transport *out of* the filtrate results in an increase in K^+ or H^+ ion transport _____.	into the filtrate
131. An increase in plasma potassium levels results in the secretion of _____, which indirectly leads to secretion of potassium by the DCT and collecting duct.	aldosterone
132. Hydrogen ions are secreted or resorbed (depending on the _____) in the _____, _____ and _____.	pH of the blood; PCT; DCT; collecting duct
133. Bicarbonate ions are secreted or resorbed (depending on the _____) in the _____.	pH of the blood; collecting duct
134. Amino acids can be catabolized in the liver; but the nitrogen must be eliminated from the body. If blood pH is normal, the liver makes _____ (which contains two nitrogen atoms) to dispose of nitrogen.	urea
135. Amino acids can be catabolized in the liver; but the nitrogen must be eliminated from the body. If blood pH is acidic, the liver transfers some of the nitrogen to glutamate to make _____.	glutamine

136. If blood pH is acidic, the kidney uses nitrogen from _____ to form _____, which combines with a hydrogen ion and allows it to be disposed of in the urine.	glutamine; ammonia
137. The kidneys can secrete hydrogen ions in several ways: directly by _____ dependent primary active transport, by countertransport with _____, or in combination with _____ (whose secretion also depends on countertransport).	ATP; sodium; ammonia
138. When peritubular cells in the kidney become hypoxic, they secrete _____ to stimulate the formation of more oxygen-carrying red blood cells.	erythropoietin
139. Like the liver, the renal cortex can produce glucose from non-carbohydrate precursors. The kidney uses _____ as the starting material for this purpose. The process is called _____.	glutamine; gluconeogenesis
140. Once the urine is formed, it leaves the kidneys and travels to the bladder through the _____, which are muscular tubes with three tissue layers: the lumenal _____, the _____, and the outer _____.	ureters; mucosa; muscularis; adventitia
141. The ureters enter the bladder at the base and at an angle. Because of this, increases in bladder pressure cause _____ which prevents _____.	the ureters to close; urine from being pushed back into the kidney
142. The muscularis of the ureters contracts in _____.	peristaltic waves
143. The bladder is a hollow, distensible ball of muscle lined with _____ and surrounded by a fibrous _____. (On its superior surface, the outer layer is actually the _____.) It stores urine until its disposal is convenient.	mucosa; adventitia; peritoneum
144. The mucosa of the bladder consists of _____ epithelium, which allows it to stretch easily and far, supported by a(n) _____.	transitional; lamina propria
145. The muscular layer which comprises the bulk of the bladder is the _____ muscle, and consists of _____ muscle whose fibers are arranged in three layers.	detrusor; smooth
146. At the base of the bladder, the two ureteric openings and the urethral opening for a triangle: the region of the bladder encompassed by this triangle is called the _____.	trigone
147. Bladder distension is sensed by stretch receptors in the _____. Ordinarily, the urge to urinate is felt after _____ <how much?> ml are present; this can be inhibited voluntarily, but it returns periodically as more urine enters the bladder.	detrusor muscle; ~200
148. The maximum bladder capacity is 3/4 to 1 liter; if circumstances force urine retention to (or above) this level, urination _____ or (much more serious) _____.	may occur involuntarily; the bladder may burst (especially if an abdominal impact occurs)
149. Urine leaves the bladder through the _____. This tube is _____ times longer in males than in females.	urethra; five
150. Urine is prevented from leaving the bladder prematurely by two rings of muscle: one is the voluntarily controlled _____, which can be assisted by contraction of the _____.	external urethral sphincter; levator ani
151. Urine is prevented from leaving the bladder prematurely by two rings of muscle: the involuntary _____ is formed continuous with the detrusor muscle.	internal urethral sphincter

152. In females, the outer urethral opening is immediately _____ to the vaginal opening.	anterior
153. In males, the urethra has three regions: the _____ urethra just under the bladder, the _____ urethra within the penis, and the _____ urethra which connects them.	prostatic; spongy OR penile; membranous
154. _____ is another word for urination.	Micturition
155. The lowest level of bladder control, and first to develop, is the _____: filling of the bladder sends a signal to the sacral spinal cord, and an efferent signal is sent in response which triggers _____.	sacral micturition reflex; micturition
156. As development progresses, the sacral micturition reflex comes under the control of the _____, which is located in the pons.	pontine micturition center
157. The micturition center in the _____ inhibits the pontine micturition center in the _____ to prevent socially inappropriate urination, but this control does not develop until 2-4 years of age.	frontal lobe; pons
158. Bladder filling is an active process which depends on sympathetic fibers which leave the spinal cord in the _____. These inhibit the detrusor muscle and excite the internal urethral sphincter, allowing _____.	lumbar region; the bladder to stretch
159. _____ control the contraction and relaxation of the external sphincter in response to signals from the _____ and from the stretching of the _____.	Sacral nerves; pons OR pontine micturition center; detrusor muscles
160. Contraction of the detrusor muscle (which is necessary to fully empty the bladder) is controlled by _____.	sacral nerves
161. _____ carry most of the afferent signals of detrusor stretch; if the spinal cord is intact, these signals are relayed to the pons and from there to higher brain regions.	Sacral nerves
162. Involuntary urination is called urinary incontinence. If it occurs only in small volumes when the bladder is placed under pressure, it is _____. If it is due to involuntary contractions of the detrusor muscle, it is _____.	stress incontinence; urge incontinence
163. Normally, urine is sterile. If bacteria invade the urinary system, the infection is called a(n) _____.	urinary tract infection (UTI)
164. Inflammation of components of the urinary system is common in response to bacterial or fungal infections: _____ is inflammation of the bladder.	cystitis
165. Inflammation of components of the urinary system is common in response to bacterial or fungal infections: _____ is inflammation of the urethra.	urethritis
166. _____ is inflammation that results when an infection reaches the pyelum (pelvis) of the kidney.	Pyelonephritis
167. Various health and dietary factors may lead to the formation of _____, which if small may pass on their own (with much pain!) or if large may require medical intervention.	kidney stones OR renal calculi
168. _____ refers to an abnormally low rate of urine formation caused by low _____ or kidney _____.	Anuria; glomerular hydrostatic pressure (HPg); disease

1. Total body water (as a percent of body mass) _____ from birth to old age.	declines
2. _____ is ~ 65% water by weight, while _____ is only ~ 20% water by weight: the relative proportion of these tissues controls the proportion of the body that is composed of water.	Muscle; adipose tissue OR fat
3. In a relatively lean individual, about 2/3 of their body water is _____, and roughly 1/3 is _____.	intracellular; extracellular
4. Extracellular fluid consists of fluid in two compartments: _____ and _____.	interstitial fluid; blood plasma
5. _____ fluid is a broad term which is usually taken to include CSF, serous fluid, lymph, etc.	Interstitial
6. Substances which are dissolved in the body's fluid are divided into two classes: _____, which ionize, and _____, which do not ionize. Ions, of course, are able to _____.	electrolytes; non-electrolytes; conduct an electric current
7. Because it dissociates into two particles in solution, a mole of NaCl contributes more to _____ than a mole of glucose. Such dissociation is common to many electrolytes and must be considered when calculating the _____.	osmotic pressure; tonicity of a solution
8. When ions are dissolved in solution, their concentration is often measured in _____, which is a measure of the number of _____ per _____. (NOTE: be able to convert from moles per liter to this unit if given the charge of an ion.)	milliequivalents; charges; liter
9. The major cation in extracellular fluid is _____, and the major anions are _____ and _____.	sodium; chloride; bicarbonate
10. The only cation in the extracellular fluid which makes an important contribution to osmotic pressure is _____.	sodium
11. Under the conditions normally found in the body, most proteins have a net _____ charge and so are _____ <what kind of ion?>.	negative; anions
12. The major cation in intracellular fluid is _____, and the major anions are _____ and _____.	potassium; hydrogen phosphate; negatively charged proteins
13. The volume of intracellular fluid is determined in large part by the osmolarity of the _____, which is in turn determined primarily by the _____ content of the body.	extracellular fluid (ECF); sodium
14. Water loss which is unavoidable (due to evaporation from the lungs during breathing, etc.) is _____ water loss.	insensible
15. _____ water loss accounts for about 1/3 of the daily water loss (and water lost must, of course, be replaced).	Insensible
16. Water lost in _____ and _____ accounts for roughly 1/10 of the daily water loss (which needs to be replaced).	feces; sweat
17. Water lost in _____ accounts for almost 2/3 of the daily water loss (which needs to be replaced).	urine

18. Changes in _____ is the primary trigger for release of ADH and for the sensation of thirst.	plasma osmolarity
19. _____ in plasma osmolarity inhibit the release of ADH and prevent the sensation of thirst.	Declines
20. The primary sensors for hydration which control conservation of water or the sensation of thirst are the _____ in the _____.	osmoreceptors; hypothalamus
21. The secondary sensors for hydration which sense changes in the body's hydration severe enough to cause changes in blood volume, are the _____ cells in each _____.	juxtaglomerular OR JG; kidney
22. It takes so long for liquid to be absorbed from the stomach that drinking until plasma osmolarity is correct would result in _____. For this reason, thirst must be quenched in response to sensations from the _____ and _____.	over-hydration; mouth; stomach
23. Consumption of water leads to abrupt declines in thirst to prevent over-hydration as liquid is consumed, but when insensible loss or sweating is unusually severe, this may lead to a(n) _____.	inadequate fluid intake
24. _____ and _____ can cause dysregulation of the thirst response and lead to an inadequate intake of water.	Illness; old age
25. Because urine can only be concentrated to a certain point, the minimal daily water loss through urine in an average adult is approximately _____.	500 ml
26. The insensible water loss and the minimal daily water loss through urine are together called the _____ water loss. Drinking at least this amount is necessary on a daily basis.	obligatory
27. Water stored with glycogen inside of cells enters the ECF when _____; in addition, water is a product of _____. However, most water must be obtained by ingestion.	the glycogen is used for energy; oxidative phosphorylation;
28. If insufficient water is consumed, the result is _____. Many of the consequences are due to the fact that the cells themselves lose _____. Common causes are _____ or _____.	dehydration; water; vomiting; diarrhea
29. The earliest sign of dehydration is often simply _____, followed in healthy individuals by _____, _____ and decreased _____.	fatigue; dry mouth, thirst, urine output
30. ADH is released when the hypothalamus senses a(n) _____.	slight increase in plasma osmolarity
31. In order to respond to sudden events such as blood loss, signals from sensors in the _____ respond to low blood pressure by triggering the release of ADH. Such signals are also sent if the drop in blood pressure is due to _____.	blood vessels; severe dehydration
32. When ADH levels are _____, filtered water is reabsorbed, resulting in a lower volume of concentrated urine.	high
33. Over-hydration may dilute the ECF enough that osmotic pressure will force water to enter cells; _____ cells are the most sensitive. _____ is possible and disorientation, convulsions, and death may result.	neuronal; Cerebral edema
34. Over-hydration is generally caused by _____ or _____.	renal insufficiency; extremely rapid fluid intake

35. Edema is the accumulation of fluid in _____, which may impair tissue function.	the interstitial space
36. Factors that may cause _____ include inflammation, osmotic imbalances, high blood pressure, and impaired lymphatic function.	edema
37. The level of sodium in the blood is described with the word, '_____.'	natremia
38. If the sodium content of the body changes, so does the _____. Thus, the *concentration* of sodium _____.	water content; does not change
39. The hormone _____ controls sodium resorption, and a deficiency in this hormone leads to a severe sodium loss.	aldosterone
40. Since aldosterone secretion is controlled by angiotensin II, which is in turn controlled by renin, aldosterone release is indirectly controlled by the _____ cells, which produce the renin.	juxtaglomerular OR JG
41. Aldosterone secretion is also controlled by the _____ level in the blood, which is sensed directly by the _____.	potassium; adrenal cortex
42. The heart produces _____ in response to high blood pressure. This hormone reduces blood pressure and blood volume by inhibiting release of ADH, renin, and aldosterone, and by directly causing vasodilation.	atrial natriuretic peptide (ANP)
43. The female sex hormone _____ also promotes sodium resorption and thus water retention. In contrast, the female sex hormone _____ has the opposite effect.	estrogen; progesterone
44. High levels of glucocorticoids enhance sodium _____, but often have little net effect on sodium retention because they also increase _____, which accelerates sodium excretion.	resorption; glomerular filtration rate
45. The level of potassium in the blood is described with the word, '_____.'	kalemia
46. Any change in extracellular ion concentrations which _____ the difference in potential across the membrane of an excitable cell makes it more likely that the cell will depolarize, and more difficult to repolarize.	decreases
47. Any change in extracellular ion concentrations which _____ the difference in potential across the membrane of an excitable cell makes it less likely that the cell will depolarize, and easier to repolarize.	increases
48. One of the dangers if blood pH falls too low is that as positive hydrogen ions enter the cells, _____ may leave to maintain electrical neutrality, resulting in an increase in _____.	K^+; extracellular potassium
49. In contrast to sodium, for which levels in the body are controlled by the amount _____, levels of potassium are controlled by the amount _____.	resorbed; secreted
50. In general, we consume _____ potassium, and the main function of the kidneys is to _____ potassium. In contrast, we are poorly equipped to deal with a(n) _____.	too much; eliminate excess; deficiency
51. Secretion of potassium is controlled by two factors: one is by its _____, which is sensed by the _____ in the _____.	concentration in the IF; principal cells; collecting duct

52. Secretion of potassium is controlled by two factors: one is by the hormone _____, which is released by the _____ when the level of potassium in the blood is high. This hormone causes potassium to be exchanged with sodium in the urine.	aldosterone; adrenal glands OR adrenal cortex
53. The level of calcium in the blood is described with the word, '_____.'	calcemia
54. The major reservoir for calcium in the body is the _____.	skeleton
55. The most important mineral in bone is the insoluble _____.	calcium phosphate
56. As renal resorption of _____ increases, resorption of hydrogen phosphate (HPO_4^{2-}) decreases in order to avoid formation of an insoluble precipitate in blood and tissue or in urine.	calcium
57. The most important hormonal control of calcium homeostasis is _____ hormone, which is released by the _____ in response to _____ calcium levels.	parathyroid; parathyroid glands; low
58. In the kidneys, parathyroid hormone leads to calcium _____ in the _____, which depends on the calcium-ATPase pump.	resorption or reabsorption; DCT
59. In the small intestine, parathyroid hormone causes an increase in calcium absorption due to the _____ by the _____.	activation of vitamin D; kidneys
60. In the skeleton, parathyroid hormone causes _____ to _____ bone and release calcium into the blood.	osteoclasts; dissolve
61. A minor influence on calcium concentration in blood is the hormone _____, which is released by the _____ and which encourages bone formation.	calcitonin; thyroid
62. The amount of chloride in the blood is described by the word _____.	chloremia
63. _____ is the major anion in the ECF, and is a contributor to the osmotic pressure of the blood.	Chloride
64. An upper limit to the concentrations of most anions in the blood is provided by the _____: excess levels cannot be resorbed and are lost in the urine.	carrying capacity of the transport proteins in the nephrons
65. Chloride and bicarbonate both have a(n) _____ charge. Chloride is usually resorbed in the DCT of the kidneys, but if the body needs to resorb more bicarbonate to maintain blood pH, the kidneys _____ in order to _____.	negative; resorb less chloride; maintain electrical neutrality

1.	pH is a measure of the concentration of the _____.	free hydrogen ions in a water-based solution
2.	A buffer is a substance which, when in solution, is able to _____, so that the _____.	bind or release hydrogen ions; pH remains nearly constant
3.	The strength of an acid or base refers to its _____: a strong acid, for example, will _____ in water.	ability to ionize; completely dissociate to give free H+
4.	The strict definition of _____ means a blood pH that is too low, while _____ refers to the conditions that promote the lowering of blood pH. However, in actual practice, the two terms are often treated as synonyms.	acidemia; acidosis
5.	The strict definition of _____ means a blood pH that is too high, while _____ refers to the conditions that promote the increase in blood pH. However, in actual practice, the two terms are often treated as synonyms.	alkalemia; alkalosis
6.	The normal pH of arterial blood is _____. If the pH drops 0.05 units to reach _____, the person has _____; if instead it rises 0.05 pH units, the person has _____.	7.40; 7.35; acidemia; alkalemia
7.	The pH of the body's fluids must be tightly controlled: two major effects of shifts in pH are changes in _____ and _____.	protein folding; electrolyte distribution
8.	_____ in the blood respond almost instantly to small changes in pH. Their levels can be altered by two of the body's systems: the _____ and _____.	Buffers; lungs; kidneys
9.	There are three major chemical buffer systems in the body: the bicarbonate buffer system in the _____, the phosphate buffer system in the _____ and _____, and the protein buffer system in the _____.	ECF; ICF; urine; ICF
10.	When hydrogen ions are added to a bicarbonate buffer system in the body, they bind to _____ to form _____.	bicarbonate; carbonic acid
11.	When hydrogen ions are removed from a bicarbonate buffer system in the body, _____ releases hydrogen ions which replace those that were removed.	carbonic acid
12.	When hydrogen ions are added to a phosphate buffer system in the body, they bind to _____ to form _____.	hydrogen phosphate; dihydrogen phosphate
13.	When hydrogen ions are removed from a phosphate buffer system in the body, _____ releases hydrogen ions which replace those that were removed.	dihydrogen phosphate
14.	When hydrogen ions are added to a protein buffer system in the body, they bind to the side-chains of _____ and _____.	histidine; cysteine
15.	When hydrogen ions are removed from a protein buffer system in the body, the side-chains of _____ and _____ release hydrogen ions to replace those that were removed.	histidine; cysteine
16.	There is an endless supply of carbon dioxide in the body because it is formed during _____. Most is taken in by _____ and enzymatically converted to _____.	cellular respiration; erythrocytes; bicarbonate
17.	The reaction relating carbon dioxide and the pH of an aqueous solution is _____.	CO2 + H2O <--> H2CO3 <--> H+ + HCO3-
18.	'_____' refers to a condition in which the level of CO_2 in the arterial blood is too high: '_____' refers to when the level is too low.	Hypercapnia; hypocapnia

19. CO_2 dissolved in the blood is usually denoted by '_____,' which refers to the pressure of the gas.	PCO2
20. H^+ can be removed from the blood by adding it to bicarbonate to form carbonic acid, then splitting the carbonic acid to water and CO_2; this reaction can be accelerated by increasing _____, which removes the _____ from the blood.	breathing rate; CO2
21. Alterations in the blood pH due to changes in breathing rate takes _____ <how long?>.	several minutes
22. Both hypercapnia and acidemia act on the medullary respiratory center to _____ breathing rate.	increase
23. Both hypocapnia and alkalosis act on the medullary respiratory center to _____ breathing rate.	decrease
24. The kidneys have three mechanisms by which they can raise the pH of the blood: they can deaminate glutamine and secrete H^+ bound to the resulting _____, or can produce _____ and then secrete the resulting H^+ directly or by countertransport with sodium.	ammonia; carbonic acid
25. In order for the kidneys to alter blood pH, up to _____ <how much time?> may be required.	several days
26. In response to hypercapnia, the kidneys use CO_2 to produce _____, and then secrete _____ into the urine and _____ into the blood.	carbonic acid; hydrogen ions; bicarbonate ions
27. When a large number of hydrogen ions are secreted into the urine, the bicarbonate/carbonic acid equilibrium in the urine is shifted toward formation of _____, which can enter the cells of the PCT or collecting duct and be reused. This prevents the urine from becoming too acidic.	CO2
28. Some of the hydrogen ions that are secreted into the urine are buffered by the _____ that is present there. This prevents the urine from becoming too acidic.	hydrogen phosphate
29. In response to low blood pH, PCT cells in the kidney deaminate glutamine to form _____, which is quickly protonated to _____ and secreted. This discards a hydrogen ion while preventing the urine from becoming too acidic.	ammonia (NH3); ammonium ion (NH4+)
30. Hydrogen ions are secreted into the urine by use of _____ or ______ countertransport or by use of a(n) _____.	Na+; K+; H+-ATPase
31. The secretion of hydrogen ions into urine is inhibited if the urine's pH is _____.	below 4.5
32. One of the causes of changes in the blood's pH is the ingestion or production of complex acids or bases (such as uric acid, which is produced by catabolism of nucleic acids). These are disposed of by the _____ <which organ?>.	kidneys
33. To lower the pH of the blood, type B cells in the collecting duct of the kidney can catalyze the formation of carbonic acid: to lower the pH of the blood, however, they secrete the _____ into the urine, and the _____ into the blood.	HCO3- ; H+
34. Because pH directly influences the _____ equilibria, PCO_2 in the blood varies depends on pH. A very rough estimate of the expected PCO_2 is that it will equal _____, in mm Hg. (Be able to make such an estimate.)	carbonic acid/bicarbonate; the last two digits of the pH (e.g., 41 for pH 7.41)
35. If PCO_2 is higher than expected, it indicates that respiration is _____, but it does not tell you whether this is the cause of a problem, or merely a symptom.	slower than normal

36. If PCO_2 is lower than expected, it indicates that respiration is _____, but it does not tell you whether this is the cause of a problem, or merely a symptom.	faster than normal
37. Respiratory acidosis promotes a decrease in the blood's pH that contributes to acidemia, and which is directly caused by _____. It causes PCO^2 to be _____ than expected.	insufficient exhalation of CO2; higher
38. Respiratory alkalosis promotes an increase in the blood's pH that contributes to alkalemia, and is directly caused by _____. It causes PCO_2 to be _____ than expected.	excessive exhalation of CO2; lower
39. Metabolic acidosis promotes a decrease in the blood's pH that contributes to acidemia, but is caused by the _____ or by the _____ by systems other than the respiratory system.	addition of hydrogen ions; removal of bicarbonate ions
40. Metabolic alkalosis promotes an increase in the blood's pH that contributes to alkalemia, but is caused by the _____ or by the _____ by systems other than the respiratory system.	removal of hydrogen ions (as by a reaction); addition of bicarbonate ions
41. Metabolic acidosis causes the concentration of bicarbonate to _____ as _____.	drop; bicarbonate reacts with hydrogen ions
42. Metabolic alkalosis causes the concentration of bicarbonate to _____ as _____.	rise; lost hydrogen ions are replaced by hydrogen ions from carbonic acid
43. Some medical conditions lead to combinations of _____ and _____ shifts in blood pH: some poisons, for example, directly change blood pH but also depress breathing.	respiratory; metabolic
44. One common cause of _____ is the production of excessive amounts of ketoacids (often called 'ketone bodies') in uncontrolled diabetes.	metabolic acidemia
45. One common cause of _____ is emphysema, in which the body's ability to expel carbon dioxide through the lungs is impaired.	respiratory acidemia
46. The loss of stomach acid due to vomiting, as would occur with an acute stomach illness, is one possible cause of _____.	metabolic alkalemia
47. _____ is often caused by pain or anxiety, and can be cured simply by having the patient re-breathe expelled air to slow carbon dioxide losses.	Respiratory alkalemia
48. Patients suffering from a metabolic acidosis will often breathe _____ in order to _____; this is called '_____.'	quickly; expel more CO2; respiratory compensation
49. Patients suffering from a metabolic alkalosis will often breathe _____ in order to _____; this is called '_____.'	slowly; conserve CO2; respiratory compensation
50. Patients suffering from a acidosis that is not caused by the kidneys (the kidneys can't compensate for their own failure!) will excrete fewer _____ and more _____ in the urine. This is called '_____.'	bicarbonate ions; hydrogen ions; renal compensation
51. Patients suffering from alkalosis that is not caused by the kidneys (the kidneys can't compensate for their own failure!) will excrete fewer _____ and more _____ in the urine. This is called '_____.'	hydrogen ions; bicarbonate ions; renal compensation
52. Aldosterone secretion is _____ in response to acidosis because _____ (thus, conserving sodium helps to increase _____).	stimulated; Na+ and H+ are countertransported; H+ secretion

Meiosis Review

1. Meiosis involves _____ cell divisions with one _____.	two; round of DNA replication
2. During meiosis, the number of chromosomes per cell is reduced to _____: the information that is lost will be replaced when two such cells, one from each parent, merge.	1/2 of the original number
3. During S phase in the cell cycle, DNA is exactly duplicated so that the cell can divide without loss of any information. The two duplicate chromosomes that result are called _____.	sister chromatids
4. Two chromosomes in a single cell that contain the same *type of* instruction (e.g., eye color), but not necessarily the same *instruction* (e.g., brown vs. blue) are said to be _____. That is, they are _____ of a single chromosome.	homologous; different versions
5. _____ cells contain both homologous chromosomes. (This doesn’t refer to the number of chromosomes, it refers to the number of _____.)	Diploid; different versions of each chromosome
6. Haploid cells contain only one _____ of each chromosome (although they may contain two _____).	version; copies
7. In the first round of division in meiosis, when the chromosomes separate during anaphase, the _____ separate and the _____ stay together.	homologous chromosomes; sister chromatids
8. In the second round of division in meiosis, the _____ separate.	sister chromatids
9. In meiosis, during the first prophase, four chromosomes (two copies of each _____) come together in one place. The cluster is called a(n) _____, and the event is called _____.	homologous chromosome; tetrad; synapsis
10. During synapsis, homologous chromosomes are broken and patched back together in such a way that they _____. This is called _____. This gene-shuffling greatly increases the genetic diversity of the offspring that are produced by sexual reproduction.	exchange pieces; crossing over
11. Synapsis and crossing over occur during _____ <which phase of the meiotic cell cycle>.	prophase I (or 'prophase of the first division')

1. The primary sex organs are the organs that actually _____. Sperm, the gametes produced by the male, are produced by the _____. (The singular form of this word is '_____.')	produce gametes; testes; testis OR testicle
2. The testes are formed within the _____, but because sperm can only be produced if the testes are _____ than the body, they descend shortly before birth into the _____.	abdominopelvic cavity; cooler; scrotum
3. The scrotum is a two-chambered sac at the root of the penis. The distance from the body and surface area can be altered to increase or decrease the _____.	temperature of the testes
4. The cremaster muscle _____ to increase warmth, and the dartos muscle _____ to conserve heat.	elevates the testes; wrinkles the skin of the scrotum
5. Within the testes, sperm production, or _____, occurs in the _____, which are surrounded by endocrine interstitial cells which produce the male sex hormones. A mnemonic: to begin the process, divide **AT O**utset.	spermatogenesis; seminiferous tubules
6. Two types of cells are found in the seminiferous tubules: the _____ cells, which _____, and the _____ cells, which support and _____ the sperm from the body's immune system.	spermatogenic; produce sperm; Sertoli OR sustentacular; protect
7. The cells of the seminiferous tubules are surrounded by endocrine interstitial cells which _____. These are often given the name, '_____.'	produce the male sex hormones; Leydig cells
8. Less than five seminiferous tubules are coiled into each of several hundred separate _____ which are regions of the testes that are separated from one another by _____.	lobules; septa
9. The _____ of the testes are extensions of the firm outer layer, the _____. They are the structures that physically divide the testis into several hundred _____.	septa; tunica albuginia; lobules
10. The tunica vaginalis is the _____ which surrounds _____. As with other serous membranes, it has two layers.	outer, serous membrane; each testis
11. After the sperm are nearly mature, they are transported out of the lobule where they were formed via the tubulus rectus (a straight connecting tubule), then into a network of tubules called the rete testis, and finally _____ through the _____.	out of the testis; efferent ductules
12. The efferent ductules form the _____, which is a comma-shaped organ adjoining each testis. Sperm _____ here as they travel to the _____ through the long (over 3x a man's height!) duct of the epididymis, a trip that takes 2 - 3 _____ <how long?>.	head of the epididymis; mature; tail of the epididymis; weeks
13. From the epididymis, the sperm are transported to the _____, a long tube which connects each testis to the _____ in the prostate gland, which is the region in which they are activated and begin to swim during the ejaculatory process.	ductus deferens OR vas deferens; ejaculatory duct
14. Sperm are stored for up to several months in the _____ and the _____, after which they are destroyed.	tail of the epididymis; ductus deferens
15. The ductus deferens, blood vessels, lymphatic vessels, and nerves, enter or leave the scrotum inside of the _____, a connective tissue tube. This tube travels in front of the pubis and forms a channel into the abdominopelvic cavity through the _____.	spermatic cord; inguinal canals
16. The blood entering the scrotum transfers heat to the _____, and so is already a bit below body temperature when it reaches the testes. This transfer of heat from between liquids flowing in opposite directions is an example of a(n) _____.	blood that is leaving; countertransport system
17. When the male becomes sexually aroused, peristaltic contractions conduct sperm to the _____, the widest part of the ductus deferens and the final storage site for the sperm prior to ejaculation.	ampulla

18. The _____ are adjacent to the ampulla of the ductus deferens, behind the bladder. They produce a bit more than half of the liquid which forms semen.	seminal vesicles
19. Sperm are metabolically inactive and immobile and must be transported by the peristaltic actions of the tubules and tubes through which they travel until _____.	they are mixed with the secretions of the seminal vesicles
20. Semen is a mixture of three major components: _____ fluid, which contains fructose (which the sperm use for fuel), buffers, and factors which activate the sperm; _____ secretions, which include an antibiotic; and of course, the _____.	seminal; prostatic; sperm
21. The _____ is inferior to the bladder, surrounding the _____, and produces a bit less than half of the liquid which forms semen.	prostate gland; urethra
22. When the male becomes sexually excited and is approaching orgasm, the _____ secrete an alkaline, clear mucus into the urethra to neutralize any acidity which might remain from the urine, preparing the way for the sperm.	bulbourethral glands OR Cowper's glands
23. The seminal vesicles, bulbourethral glands, and prostate gland are called the _____, because they don't actually produce gametes and yet are necessary to reproduction.	accessory glands
24. During ejaculation (which normally follows a period of sexual stimulation), the sympathetic system causes the muscular ducts and accessory glands to contract, expelling their contents into the _____ where they mix to form _____.	urethra; semen
25. During ejaculation, the _____ to prevent urine (which would kill sperm) from leaking into the urethra.	bladder sphincter constricts
26. During ejaculation, the _____ contracts rhythmically to propel the semen from the urethra at high velocity. (The farther the semen travels, the more likely the encounter between sperm and egg.)	bulbospongiosus
27. During sexual intercourse, the erect penis penetrates far into the female's vagina to deliver the sperm as close as possible to the location where _____.	an encounter with an egg is likely
28. The penis has three regions: the attached _____ which connects it to the body, the _____ or _____, which is the columnar portion, and the slightly larger tip, the _____.	root; shaft; body; glans penis
29. The penis consists largely of three long cylinders consisting of _____. Blood flow into this tissue can be regulated: under resting conditions, blood delivery is just enough to provide _____ and _____/_____ exchange.	erectile tissue; oxygen; nutrient; waste
30. The urethra travels through one of the erectile bodies: the _____.	corpus spongiosum
31. During an erection, arteriole blood delivery to the two _____ and the _____ increases, causing them to engorge with blood. This compresses the veins and venules which leave these structures against the outer fibrous layer, the _____ of the erectile bodies.	corpora cavernosa; corpus spongiosum; tunica albuginea
32. The changes in _____ that occur during erection cause the normally flaccid penis to extend and stiffen as it _____. These events are controlled by the _____ nervous system.	blood flow; fills with blood; parasympathetic
33. The neurotransmitters responsible for penile erection are _____ and _____.	acetylcholine; nitric oxide (NO)
34. During penile erection, blood flow through the penis is _____; indeed, 'priapism,' or abnormally prolonged erection, is an extremely painful condition that can lead to tissue damage or tissue death.	greatly reduced

35. Penile erection is required for _____, but may also occur in response to other stimuli such as _____; it also occurs during certain phases of the _____.	sexual intercourse; bladder fullness; sleep cycle
36. Ejaculation is controlled by the _____ nervous system. Normally, erection precedes sexual activity and ejaculation, but the two events are distinct and may occur separately.	sympathetic
37. The glans penis is hidden by an encircling fold of skin called the _____; for various cultural reasons, this is often removed in a procedure called _____.	prepuce OR foreskin; circumcision
38. During the formation of sperm, each cell division brings the sperm-to-be closer to the _____ of the _____.	lumen; seminiferous tubule
39. The cells which are farthest from the lumen, and which divide only by mitosis, are the _____.	spermatogonia
40. During childhood, spermatogonia divide only to increase their number. After puberty, each division produces one replacement cell called a(n) _____ and one _____, which is destined to change with each division, ultimately forming mature sperm.	type A daughter cell; type B daughter cell
41. After its formation, each type B cell is pushed _____ of the seminiferous tubule. It soon reaches a point at which it is ready to divide again, and here this cell is called a(n) _____.	toward the lumen; primary spermatocyte
42. Each primary spermatocyte passes through meiosis, producing four _____; these are cells which contain the genetic material that they need to be sperm cells, but which do not yet have the correct structure. (A(n) _____ **I**sn't **D**iploid.)	spermatids; spermatid
43. The process by which spermatids mature to become sperm is called _____. A mnemonic: I'm almost done, **I O**nly need to mature.	spermiogenesis
44. Spermatogonia, their daughter cells, primary spermatocytes, and spermatids are all (as a group) called _____.	spermatogenic cells
45. The sperm that are released into the lumen of the seminiferous tubules seem mature in many ways, but even if they are somehow included in the ejaculate, they will not be able to _____.	swim
46. The sperm is a specialized cell which swims well by using ATP supplied by many mitochondria in the _____; a long _____, or flagellum, for propulsion; and a bullet shaped _____ which contains the _____ to deliver the genetic material to the egg.	midpiece; tail; head; DNA
47. In addition to the DNA, the head of the sperm (at its very tip) also contains the _____, a specialized lysosome which contains enzymes which are released on impact with an egg, allowing the sperm to _____.	acrosome; penetrate the egg's surface
48. _____ surround each seminiferous tubule. The tight junctions between these cells prevent contact between the _____ and the _____, which would result in destruction of the sperm by the immune system.	Sertoli or sustentacular cells; sperm; blood
49. _____ surround the spermatids and immature sperm until they are released into the lumen of the seminiferous tubule; they provide it with nutrition, guide its movements, and secrete the testicular fluid which provides nutrients and growth signals.	Sertoli or sustentacular cells
50. Spermatogenesis and testosterone release are controlled by the hypothalamus, which releases _____, a hormone that indirectly stimulates both processes.	gonadotropin releasing hormone (GnRH)
51. GnRH binds to receptors in the _____, which releases _____ and _____ in response.	anterior pituitary; follicle stimulating hormone (FSH); luteinizing hormone (LH)

52. FSH stimulates _____ cells to release _____; this in turn causes the _____ to increase their binding of, and thus response to, testosterone.

    Sertoli or sustentacular; androgen binding protein (ABP); spermatogenic cells

53. LH stimulates _____ to release _____.

    interstitial cells OR Leydig cells; testosterone

54. Sperm maturation depends upon _____, the hormone which controls it.

    testosterone

55. GnRH secretion is inhibited by the last hormone in the sequence of hormones which it controls: _____. Its release is also inhibited by _____, a hormone released by the Sertoli (or sustentacular) cells when the sperm count is _____.

    testosterone; inhibin; too high

56. Testosterone is active without chemical change in many cells in the body, including the _____ (which enlarge) and _____ (which becomes denser). In other cells it must be converted to another form, _____, in order to have an effect.

    muscles; skeleton; DHT

57. Testosterone is the main stimulus for sex drive in _____. This is possible because the _____ also produce low levels.

    both males and females; adrenal glands

1. _____ (this singular form of this word is _____), the gametes produced by the female, are produced by the _____.	Ova; ovum; ovaries
2. The ovaries are within the _____, 3-4 cm to each side of the medial plane and just above the level of the pubis.	abdominopelvic cavity
3. All of the internal female reproductive organs, including the ovary, are held in place by the _____, which is part of the peritoneum. The part of this which anchors the ovary itself is the _____.	broad ligament; mesovarium
4. An extension of the broad ligament projects from the top of the ovary to the pelvic wall, and is called the _____. It forms a tube which surrounds the _____. The bottom of the ovary is anchored to the uterus by the _____.	suspensory ligament; ovarian blood vessels; ovarian ligament
5. The ovary itself consists of two regions with _____ boundaries: the central medulla and the outer cortex. Each ovary is surrounded by the firm and fibrous _____ and a layer of simple cuboidal epithelia, the _____.	imprecise; tunica albuginea; germinal epithelium
6. Blood vessels, lymphatic vessels, and nerves all travel directly to the _____ of the ovary.	medulla
7. The ovarian cortex contains many _____, millions of which are formed before birth by division of the _____ as _____ begins. Unlike the male, gamete formation in females takes many years.	primary oocytes; oogonia; oogenesis
8. The primary oocytes are arrested in _____ <stage of cell cycle>. Only hundreds of the original millions will ever progress through the remainder of the cycle.	prophase I
9. The primary oocytes become surrounded by _____ shortly after their formation; the resulting structure is called a(n) _____. In the adult, hundreds of thousands of these can be observed in the _____; the rest of the original millions have died.	a single layer of follicle cells; primordial follicle; ovarian cortex
10. _____ follicles can be dormant for decades. They are very small. The oocyte is surrounded by a single layer of squamous cells.	Primordial
11. After puberty and through middle age, cyclic hormonal changes control a roughly _____ <how many> day _____ cycle. (The exact length varies.) It includes a few days of mild bleeding, the onset of which is easily noted and is thus designated as _____.	28; menstrual; day 1
12. For each individual follicle, folliculogenesis spans _____ menstrual cycles.	thirteen
13. Several _____ are "recruited" during each menstrual cycle, and over roughly _____, mature to become primary follicles.	primordial follicles; five months
14. _____ are much larger than primordial follicles, but still microscopic. The granulosa cells are cuboidal and are dividing by mitosis.	Primary follicles
15. The _____ divide during follicular development. Two features quickly become evident: a transparent region or zone around the oocyte, called the _____, and outer layer called the _____. A(n) _____ follicle is one in which these structures have formed.	granulosa cells; zona pellucida; theca; secondary
16. The external theca is _____ that merges with the ovary itself, while the internal layer synthesizes _____.	connective tissue; ovarian hormones
17. The tertiary stage is reached roughly _____ after recruitment.	nine months

18. At the start of each menstrual cycle, an increase in follicle stimulating hormone causes five to seven _____ to grow up to ten times in size.	tertiary follicles
19. Only one _____ will be dominant - it will reach a diameter of ~ 2 cm (roughly the diameter of a penny) and release the secondary oocyte.	tertiary follicle
20. Most follicles that reach the tertiary stage _____.	die
21. The follicles that don't reach maturity are thought to be needed to produce the _____, _____ and _____.	ovarian hormones; estrogens; progesterone
22. As follicular development within the ovary continues, a fluid filled vesicle called the _____ forms. The oocyte remains on one side, surrounded by a cluster of _____ called the cumulus mass.	antrum; granulosa cells
23. Follicles in which the _____ has formed are mature _____ or _____, follicles.	antrum; vesicular; Graafian
24. Ovarian follicles which have matured to the _____ stage are several mm in diameter, and cause the ovary to look like a small bag of marbles.	Graafian follicle
25. Ultimately, one Graafian follicle reaches full maturity. The primary oocyte completes _____ to form a small _____ and a larger _____ which, along with a cluster of cells from the cumulus mass, the _____, are released when the follicle ruptures.	meiosis I; polar body; secondary oocyte; corona radiata
26. Although it may undergo one more cell division, the _____ is destined to die. The secondary oocyte needs all of the nutrient-containing cytoplasm in case fertilization occurs.	first polar body
27. The rupture of a Graafian follicle and release of the secondary oocyte is called _____.	ovulation
28. On very rare occasions, two follicles mature and rupture together. Conception and birth resulting from these events gives rise to _____.	non-identical (fraternal) twins
29. The cells of the dominant Graafian follicle which remain in the ovary after ovulation increase in size and form a yellow endocrine gland called the _____. This secretes _____ (and a relatively small amount of _____).	corpora luteum; progesterone; estrogen
30. If pregnancy occurs, the corpora luteum is maintained until _____; if not, it degenerates in roughly _____ <how long?> and forms a small white scar, the _____.	the placenta is functional; 14 days; corpus albicans
31. The time prior to ovulation is the _____, named for the developing Graafian follicles, and the time following it, the _____, named after the _____.	follicular phase; luteal phase; corpus luteum
32. The secondary oocyte which was released during ovulation is carried by the _____ away from the ovary and toward the _____. (Each ovary has such a structure leading away from it.)	fallopian tube OR uterine tube OR oviduct; uterus
33. Although the uterine tubes widen to form the _____, a funnel-shaped region near the ovary, and this possesses fingerlike structures called _____ which surround the ovary, there is _____ between them. Some oocytes are lost into the _____.	infundibulum; fimbriae; no contact; abdominal (peritoneal) cavity
34. The surface of the fimbriae which faces the ovary is _____, and the motion of the cilia greatly increases the odds that the oocyte will follow the correct path.	ciliated
35. The longest region of the uterine tube is the wide _____; it is here that the sperm and oocyte usually meet.	ampulla

36. Until and unless the secondary oocyte meets a sperm, it remains in _____. If it does meet a sperm, it continues division and a mature _____ (already fertilized!) and a(n) _____ result.	meiosis II; ovum; polar body
37. The walls of the uterine tube are _____ and the inner surface is _____; the oocyte is propelled actively toward the uterus. The inner surface also contains secretory cells which secrete _____ and _____.	muscular; ciliated; lubricating mucus; nutrients
38. The outermost layer of the uterine tubes is _____, continuous with the _____. The uterine tube is held in place by a division of the _____ called the mesosalpinx.	serosa; peritoneum; broad ligament
39. From the uterine tube, the oocyte - whether it has been fertilized or not - enters the _____ of the uterus, the uppermost largest region. From there it proceeds to the _____ of the uterus; if fertilization has occurred, this is where it is likely to stay.	fundus; body
40. The uterus is a highly muscular organ, supported by a portion of the _____ ligament, as well as the _____ ligament at the cervix, the _____ ligament in the back, and the _____ ligaments in the front (which actually leave the abdominal cavity and wrap around the pubis to reach the genitals)	broad; lateral cervical; uterosacral; round
41. The outermost layer of the uterus is the _____; the thick muscular layer the _____; and the inner layer the _____, which includes a region that grows thicker in preparation for pregnancy, and is then discarded if no pregnancy occurs.	perimetrium; myometrium; endometrium
42. The _____ of the uterus is a small, donut-shaped gateway, closed by mucus to protect the uterus until ovulation makes conception possible.	cervix
43. At the same time that the follicle is maturing, the uterus is preparing itself for _____ 'just in case.'	pregnancy
44. The endometrium of the uterus has two layers: the _____ is the functional layer, which cyclically grows thicker and develops a rich blood supply, then dies back. Farther from the lumen of the uterus is the _____, from which the functional layer grows.	stratum functionalis; stratum basalis
45. Although the 'menstrual cycle' generally refers to all of the cyclic reproductive changes which occur in the young adult female, the phrase is sometimes used to refer specifically to the _____.	uterine cycle
46. Because it is easy to identify without ambiguity, the first day of the uterine cycle is the day on which the _____ of the endometrium begins to be shed, emerging from the vagina together with blood in a process called _____.	stratum functionalis; menstruation
47. Approximately the first _____ days of the uterine cycle constitute the _____ phase, during which the surface of the endometrium is shed and discarded via the vagina.	5; menstrual
48. During the first few days of the menstrual cycle, follicles within the ovary are beginning to mature, and as they do they secrete _____. As the follicles get larger, the levels of this hormone rise, and the endometrium of the uterus responds by _____.	estrogens; growing thicker
49. The phase of the uterine cycle during which the stratum functionalis of the uterus is growing thicker is the _____. It begins around day _____ and lasts for roughly _____ days.	proliferative phase; 6; 8
50. The proliferative phase of the uterine cycle ends when _____, secreted by the corpus luteum after ovulation, signals the endometrium that pregnancy could occur at any moment. The stratum functionalis is converted to a(n) _____ in response.	progesterone; secretory mucosa
51. The phase of the uterine cycle following ovulation is the _____ phase, and corresponds to the _____ phase of the ovarian cycle. Its starting date varies somewhat, since the time of ovulation varies, but it lasts almost exactly _____ days.	secretory; luteal; 14
52. During the secretory phase of the uterine cycle, _____ within the endometrium develop and begin secreting fluid which contains glycogen, which could serve as fuel for the embryo until it can obtain it from the mother.	spiral glands

53. If pregnancy does not occur, the corpus luteum degrades and so progesterone levels fall. Without progesterone, the _____ (which supply blood to the endometrium) spasm and the _____ dies. Ultimately, these spasms cause the dying tissue to detach.	spiral arteries; stratum functionalis
54. If fertilization has not occurred, the egg will eventually be washed into the lower region of the uterus, the _____, and from there through the _____, then the _____, and finally out of the body.	isthmus; cervix; vagina
55. The vagina is a thin tube which connects the cervix to the exterior of the body. It consists of three layers; the luminal _____, the _____, and the innermost _____.	mucosa; muscularis; adventitia
56. Despite the name of the luminal layer, the vagina lacks mucous glands: mucus is provided by the _____, and an acid environment which discourages the growth of pathogens is maintained by _____.	cervix; symbiotic bacteria
57. The outer opening of the vagina is sometimes closed or partially closed at birth by a membrane called the _____. (The presence of this membrane varies from person to person.)	hymen
58. The upper end of the vagina extends upward to surround the cervix, forming a recess called the _____.	vaginal fornix
59. The menstrual cycle is controlled hormonally. The maturation of the follicles in the ovaries is triggered by _____, which is released by the _____.	follicle stimulating hormone (FSH); pituitary
60. After ovulation, the conversion of the remaining follicle cells to the corpus luteum is stimulated by _____.	luteinizing hormone (LH)
61. The secretion of estrogens by ovarian follicles is a two part process: _____ stimulates the theca interna to produce androgens, and _____ stimulates the granulosa cells to convert androgens to estrogen.	FSH; LH
62. FSH and LH release are controlled by _____, which is produced by the _____.	gonadotropin releasing hormone (GnRH); hypothalamus
63. Secretion of both FSH and LH is stimulated by a very high level of _____, so that as the follicles reach maturity, the FSH and LH levels _____. The surge in LH levels triggers _____.	estrogen; surge; ovulation
64. After ovulation, one of the hormones released by the corpus luteum, _____, has a direct negative effect on LH and FSH release.	inhibin
65. In developed countries, menstruation generally begins between the ages of 11-12: the exact age depends on many factors including _____. The first menstrual cycle is called _____.	nutrition; menarche
66. The menstrual cycle does not continue throughout a woman's life: it generally stops in middle age, in a process or condition called _____.	menopause
67. The vagina opens into an indentation called the _____. It is immediately posterior to the opening of the _____.	vestibule; urethra
68. The vestibule is flanked on either side by thin folds of sensitive skin called the _____ (each one is a single _____). These meet anteriorly to form the _____, a hoodlike covering for the _____, which is the center for much of a female's sexual sensation.	labia minora; labium minus; prepuce; clitoris
69. The clitoris contains two tubes of erectile tissue (as does the penis in the male), the _____. Although much smaller, the clitoris, like the male penis, becomes erect. Thus usually results only in an increase in _____, not in _____.	corpora cavernosa; diameter; length

70. Deep within the vestibular floor, on either side of the vagina, erectile tissue corresponding to the male's corpora spongiosum is found. Each of these (one on each side) is a(n) _____.	bulb of the vestibule
71. On either side of the vestibule lie greater and lesser _____, which produce lubricating fluid.	vestibular glands
72. On either side of the labia minora are the _____ (each one is a single _____), which are large ridges filled with adipose tissue. In most positions (although it varies from person to person), these meet and thus enclose the deeper structures.	labia majora; labium majus
73. The region of the perineum lying between the vagina and the anus is the _____, so-called because it is often torn or cut during childbirth.	clinical perineum
74. The area immediately anterior to the labia major (and continuous with them) is the _____, named because it is essentially a small hill of adipose tissue resting on the pubis.	mons pubis
75. Taken together, the external female genitalia are often referred to as the _____.	vulva
76. During puberty, development of secondary sexual characteristics in the female is stimulated by _____.	estrogen
77. The function of the _____ is to provide milk for the newborn. Although present in both genders, their development is dependent on the hormone _____, and so it does not normally occur in males.	mammary glands or breasts; estrogen
78. In non-lactating women, most of the breast's mass is composed of _____. The _____, which actually produces the milk, enlarges during lactation, however.	adipose tissue; mammary gland
79. Each mammary gland consists of 15-25 cone shaped _____; the point of each cone lies within the nipple. Milk that is produced in each is secreted through a private _____ duct which opens on the nipple's surface.	lobes; lactiferous
80. Each lobe within a mammary gland contains smaller _____; when a woman is lactating, these contain glandular _____ which produce milk. (These structures are collapsed and dormant in the absence of lactation.)	lobules; alveoli
81. The mammary glands are surrounded by adipose tissue and held in place by a netlike set of ligaments called the _____. (Over time, the weight of the breasts can cause these ligaments to permanently stretch.)	Cooper's ligaments
82. The milk is drawn from the breast by suction as a baby eats. Each nipple is surrounded by a circular band (pigmented in some individuals) called the _____, which contains _____ glands whose secretions protect the nipple during nursing.	areola; areolar
83. The skin of the _____ is very sensitive to touch, more so when lactating. (In many women, this evokes a pleasant sensation.) The smooth muscles under the skin respond by contracting, causing the nipple to _____.	areolae; become erect

1. During ejaculation, _____ <how many?> sperm are ejected into the vagina, but _____ due to leakage, destruction, or inability to penetrate the mucus of the cervix.	several hundred million; most are lost
2. In order to be fertilized, the secondary oocyte must encounter a sperm within _____ of ovulation. (Sperm can live in the female reproductive tract for up to _____.)	12 to 24 hours; 1 to 3 days
3. The secondary oocyte is protected by two structures, a cluster of cells called the _____ and a clear glycoprotein coat called the _____.	corona radiata; zona pellucida
4. To penetrate the egg, the acrosome of sperm must _____ to release _____. To prevent early release, each sperm's acrosome is inactive until _____.	rupture; digestive enzymes; long after it enters the vagina
5. The acrosomes of sperm cannot rupture until they are exposed for several hours to fluids in the vagina, uterus, and fallopian tubes. This preparation of the acrosome for use is called _____.	capacitation
6. Only one sperm will actually fertilize the egg, but that one sperm needs the help of many others in order to _____ so that it can reach the egg. Essentially, the egg's defenses fail when attacked by hundreds of sperm.	dissolve the zona pellucida
7. The membrane covering the acrosome contains receptors which bind to proteins of the zona pellucida. This binding triggers the _____, which causes the _____.	acrosomal reaction; release of digestive enzymes
8. The first sperm to penetrate the zona pellucida will bind to a receptor on the oocyte's membrane. This triggers two events: the first sperm _____, and other sperm are _____.	enters the oocyte's cytoplasm; blocked from entry
9. There are two mechanisms which prevent more than one sperm from entering an oocyte. The first is the _____, which occurs when the membrane of the _____ and prevents similar binding by other sperm cells.	fast block to polyspermy; oocyte depolarizes
10. The _____ block to polyspermy results in the release of _____, which are specialized vesicles. This leads to the denaturation of the zona pellucida's proteins, including _____.	slow; cortical granules; the receptors to which sperm bind
11. The entry of the sperm into the oocyte causes the oocyte to activate. As a result, it _____, becoming the _____ and producing a small, cytoplasm-free cell, the second polar body. (Recall that the first one was produced during _____.)	finishes meiosis II; ovum; oogenesis
12. Inside the oocyte, the sperm's head and tail separate. The sperm's nucleus swells to form the _____, and migrates to the center of the ovum where it joins with the _____ (which was formed when the oocyte completed meiosis II).	male pronucleus; female pronucleus
13. It's not until the male and female _____ fuse to form a diploid nucleus that the joined sperm and egg can be called a(n) _____ (which means _____).	pronuclei; zygote; fertilized, diploid egg
14. Fertilization usually occurs in the _____ or _____ of the uterine tube; cell division begins there, and continues until the growing mass of cells _____.	infundibulum; distal ampulla; implants in the wall of the uterus
15. Almost immediately after fertilization, the zygote begins to _____; a small, berry like structure called the _____ is formed by day 3, and a hollow ball of cells called the _____ has been formed by day 4.	divide rapidly; morula; blastocyst
16. The formation of the blastocyst is called _____.	blastulation
17. During pre-embryonic development, mitosis and cytokinesis occur without _____. This process is called _____. As a result, the entire blastocyst, which contains ~100 or so cells, is roughly _____ <how large?>.	growth between divisions; cleavage; the same size that the ovum was

18. The blastocyst is a hollow ball. The outer wall is the _____, and the cluster of cells inside is the _____.	trophoblast; inner cell mass
19. The cells of the _____ are still pluripotent, and can form any tissue or even complete individuals.	inner cell mass
20. The trophoblast will eventually develop into the _____, while the inner cell mass will eventually form one or more _____.	placenta and supporting structures; embryos
21. The _____ reaches the uterus around four days after ovulation. It remains there as the _____ breaks up, during which time it is nourished by uterine secretions.	blastocyst; zona pellucida
22. Implantation begins about 6–7 days after ovulation; in this process, the cells of the trophoblast which are closest to the inner cell mass _____. This process continues until the blastocyst is _____, and takes several days.	digest their way into the endometrium; completely embedded
23. To prevent menstruation, the cells of the blastocyst release _____ for the first _____ months of pregnancy. This promotes the survival of the corpus luteum until the placenta is mature enough to produce large amounts of _____ and _____.	human chorionic gonadotropin (hCG); four; progesterone; estrogen
24. High levels of estrogen and progesterone can cause an unpleasant side effect in the early months of pregnancy: _____.	morning sickness
25. The placenta is a temporary organ which forms in the uterus to allow the blood of the mother and the unborn child to _____. It also acts as a(n) _____ to shield the fetus from at least some harmful substances.	exchange chemicals and gases without mixing; filter
26. Before implantation, the boundary between the inside of the blastocyst and the outside is a single layer of cells called the _____. Eventually, cell division and differentiation lead to a more complex boundary called the _____.	trophoblast; chorion
27. After implantation, trophoblast cells divide rapidly and the outermost cells _____. _____ grow from the surface, and become _____ as surrounding blood vessels are dissolved. This is the very early _____.	fuse to form a syncytium; Villi; bathed in maternal blood; chorion
28. The placenta forms from the _____ and the _____ which lie between the embryo and the wall of the uterus. The _____ in other regions deteriorate, forming the smooth chorion.	endometrium; chorionic villi; chorionic villi
29. The placenta is fully functional by _____ <when?>.	the 3rd month after fertilization
30. The _____ connects the developing embryo to the placenta until birth.	umbilical cord
31. The _____ channels blood from the umbilical cord past the fetal liver, directly to the vena cava.	ductus venosus
32. Together, the foramen ovale, ductus arteriosus, and ductus venosus are known as the _____.	vascular shunts
33. The development of ectoderm, mesoderm, and endoderm from the _____ is called _____, and the embryo is referred to as a(n) _____. All three layers are present roughly _____ <how long?> after conception.	inner cell mass; gastrulation; gastrula; 16 days
34. Early in gastrulation, a two-chambered ball of cells on a connecting stalk forms. One chamber is the _____, and the other the _____: the wall between them is the _____, and will actually form the embryo.	amnion; yolk sac; embryonic disk

35. The _____ is a fluid-filled sac which will eventually surround the fetus. At first the fluid is derived directly from the _____, but by birth much of its volume is _____. It provides cushioning and support, and _____, during development.	amnion; maternal blood; fetal urine; room to move
36. Cells of the yolk sac form the earliest _____, contribute the formation of the _____, and become the _____ or _____ of the fetus.	blood cells; gut; spermatogonia; oogonia
37. A projection formed by the yolk sac, the _____, eventually helps to form the umbilical cord and its base becomes the _____.	allantois; urinary bladder
38. The brain and spinal cord begin to form within two weeks of fertilization, a process called _____.	neurulation
39. The cerebrum and other brain regions become recognizable roughly _____ <how long?> after fertilization, although its development is far from complete - the central sulcus, for example, does not appear until roughly _____ <how long?> after fertilization.	eight weeks; twenty weeks
40. A rudimentary circulatory system and a beating heart are present by the start of the _____ <which week?> after fertilization.	4th week
41. Organogenesis is the formation of organs and organ systems; by the end of the _____, all organ systems are recognizable.	embryonic period
42. The medical community assumes that the mother will not know which sexual act led to conception, and calculates fetal age based on the time that has passed since _____. Developmental biologists, however, calculate age based on the time since _____.	the last menstrual period; fertilization
43. From the beginning of the _____ <which week?> after conception, when organ systems are _____, the developing child is no longer an embryo, but is instead called a(n) _____.	9th week; present but not yet fully functional; fetus
44. Survival of the fetus outside the mother is not possible until at least _____ weeks after fertilization, a time referred to as the edge of viability. At this point, major _____ will be required, and lifelong _____ may result even if the child survives.	22; medical intervention; disability
45. Even late in pregnancy, chemicals and disease affecting the mother can still cause _____: the brain, for example, continues to develop even _____. Chemicals that cause developmental abnormalities in the developing embryo or fetus are ______.	birth defects; after birth; teratogens
46. The last two months of _____ ('before birth') development include the production of _____ by the lungs, to allow breathing, and the storage of _____ for use as energy and insulation.	prenatal; surfactant; subcutaneous fat
47. During pregnancy, the uterus enlarges dramatically: the woman’s center of gravity _____ and an accentuated _____ often results.	shifts forward; lumbar curvature (lordosis)
48. Heartburn and constipation may result due to _____ and _____ of the GI tract.	displacement; decreased mobility
49. Upward pressure of the abdominal organs against the diaphragm as pregnancy reaches its final stages causes many women to suffer from _____.	difficult breathing OR dyspnea
50. Near the end of pregnancy, placental production of the hormone relaxin causes _____ and _____ to soften and relax. A side-effect is that _____ of the body also respond.	pelvic ligaments; the pubic symphysis; other ligaments
51. The placenta produces _____, which helps to promote the maturation of the breasts for lactation and shifts the mother's metabolism to burn more fat, sparing glucose for the fetus.	human placental lactogen (hPL)

52. Metabolic wastes are transferred from the fetal blood to the mother's and so the mother's _____ to cope.	kidneys must produce more urine
53. _____ during pregnancy can cause difficulties ranging from discomfort to incontinence.	Uterine pressure on the bladder
54. Blood volume increases to accommodate the needs of the fetus, leading to increases in the mother's _____.	blood pressure and heart rate
55. Parturition is the process of giving birth, and usually occurs between _____ and _____ days after the last menstrual period (LMP).	265; 295
56. During the last few weeks of pregnancy, estrogen levels rise, stimulating myometrial cells of the uterus to form _____, and antagonizing progesterone's inhibition of _____.	oxytocin receptors; uterine contractions
57. As the time of birth approaches, the fetus usually changes position until _____.	the head is below the feet
58. Labor is thought to be triggered by the release of _____ by the fetal adrenals, which causes the placenta to produce _____ which _____, leading to contractions.	corticosteroids; prostaglandins; irritate the wall of the uterus
59. Contraction of the uterus pushes the fetus against the cervix. _____ signals the posterior pituitary to release _____, which further increases uterine contractions.	Stretching of the cervix; oxytocin
60. Labor is divided into three stages: the _____, _____ and _____ stages.	dilation; expulsion; placental
61. The dilation stage of labor extends from onset of labor to the time when _____.	the cervix is fully dilated (about 10 cm in diameter)
62. At some time during the dilation stage, the amniotic sac will _____ (or a medical care worker will see that it happens when dilation is nearly complete, if necessary). This is known as the _____.	rupture; water breaking
63. Uterine contractions lasting ~ 10 to 30 seconds each generally occur _____ <how often?> early in the dilation stage of labor.	every 15 to 30 minutes
64. The dilation stage of labor varies greatly in length, but the average is _____ <how long?>.	6 - 12 hours
65. Thinning out and softening of the cervix is called _____ and must occur before or in conjunction with dilation.	effacement
66. The expulsion stage extends from _____ until the time the infant is delivered. As this stage approaches, the urge to assist the labor process with _____ becomes intense. (This urge varies depending on which method is chosen for pain reduction.)	full dilation; the abdominal muscles
67. Normally, the head is delivered first. Deliveries in which the baby is in another position may require interventions ranging from _____ to _____.	repositioning; surgical delivery
68. Surgical deliveries (_____) are sometimes needed (although it is argued by many that they are not needed nearly so often as they are performed) to ensure that the blood flow to the fetus is not _____.	Cesarean sections; interrupted during delivery

69. _____ occurs when the infant's head enters the _____ early in the dilation stage of labor.	Engagement; true pelvis
70. Uterine contractions lasting ~ 1 minute each generally occur _____ <how often?> during the expulsion stage of labor.	every 2 to 3 minutes
71. The expulsion stage of labor is typically_____ in length.	30 minutes to 2 hours
72. _____ refers to the point in time at which the widest part of the infant's head enters the _____ during the expulsion stage of labor.	Crowning; vulva
73. The third and final stage of labor is the _____, in which the placenta and attached fetal membranes, no longer needed, are expelled.	placental stage
74. The newborn baby is called a(n) '_____.'	neonate
75. The placental stage of labor occurs _____ <when?> following the birth of the neonate.	within the half hour
76. Within the first few seconds of postnatal life, _____ will cause it to take the first breath, inflating the lungs.	rising carbon dioxide levels in the neonate's blood
77. Within five minutes of birth in a medical environment, the Apgar score is used to assess the infant's physiological status based on _____, _____, _____, _____ and _____.	Appearance; Pulse rate; Grimacing reflex; Activity; Respiration
78. Within a half an hour after birth, the umbilical arteries and veins close and begin to fibrose; eventually all that will remain are _____	ligaments
79. A flap of tissue covers the foramen ovale: _____, it is sealed to become the _____.	within a year; fossa ovalis
80. Blood flow through the ductus arteriosus stops within a half hour of birth, and it eventually becomes the _____.	ligamentum arteriosus
81. During pregnancy, high hormonal levels stimulate the growth of the _____ and _____ of the breasts. In addition, the _____ <phrase>, presumably to make them easy for the infant to find.	glandular structure; adipose tissue; areolae darken and enlarge
82. Prolactin, as its name suggests, promotes _____.	milk production
83. Prolactin production by the anterior pituitary begins before birth, but milk production is limited until _____ after birth.	estrogen and progesterone fall
84. The baby's suckling stimulates the nipples to send signals to the hypothalamus, which responds by causing the posterior pituitary to release _____, and the anterior pituitary to release _____.	oxytocin; prolactin
85. Oxytocin causes the _____ reflex, resulting in the _____ by both breasts.	let-down; expulsion of milk

86. For the first few days after birth, the breasts secrete _____ instead of true milk. This fluid is rich in protein, vitamin A, and protective antibodies which escape digestion in the newborn's stomach and thus offer protection.	colostrum
87. Nursing partially disrupts the _____. However, if nursing is continued, it eventually resumes (although the timing may initially be irregular).	ovarian cycle
88. Although the amniotic fluid and GI tract of the developing newborn contain solid waste, defecation does not normally occur until _____. The first bowel movement consists of this material, called _____; its rapid elimination is promoted by breast milk.	after birth; meconium

Appendix 1

Blood		The Heart		Blood Vessels		The Lymphatic System	
1.	B1a	1.	H1	1.	BV1	1.	LS1
2.	B2	2.	H2	2.	BV2	2.	LS2
3.	B3	3.	H3	3.	BV3	3.	LS3
4.	B4	4.	H4	4.	BV4	4.	LS4
5.	B5	5.	H5	5.	BV5	5.	LS5
6.	B6	6.	H6	6.	BV6	6.	LS6
7.	B7	7.	H7	7.	BV7	7.	LS7
8.	B8	8.	H8	8.	BV8	8.	LS8
9.	B9	9.	H9	9.	BV9	9.	LS9
10.	B10	10.	H10	10.	BV10	10.	LS10
11.	B11	11.	H11	11.	BV11	11.	LS11
12.	B12	12.	H12	12.	BV12	12.	LS12
13.	B13	13.	H13	13.	BV13	13.	LS13
14.	B14	14.	H14	14.	BV14	14.	LS14
15.	B15a	15.	H15	15.	BV15	15.	LS15
16.	B16	16.	H16a	16.	BV16	16.	LS16
17.	B17	17.	H17	17.	BV17	17.	LS17
18.	B18	18.	H18	18.	BV18	18.	LS18
19.	B19	19.	H19a	19.	BV19	19.	LS19
20.	B20	20.	H20	20.	BV20	20.	LS20
21.	B21	21.	H22	21.	BV21	21.	LS21a
22.	B22	22.	H23a	22.	BV22	22.	LS21b
23.	B23	23.	H24	23.	BV23	23.	LS22
24.	B24	24.	H25	24.	BV24	24.	LS23
25.	B25	25.	H26a	25.	BV25	25.	LS24
26.	B26	26.	H27	26.	BV26	26.	LS25
27.	B27	27.	H28	27.	BV27	27.	LS26
28.	B28	28.	H30	28.	BV28	28.	LS27
29.	B29	29.	H31	29.	BV29	29.	LS28
30.	B30	30.	H32	30.	BV30	30.	LS29
31.	B31a	31.	H33	31.	BV31	31.	LS30
32.	B32	32.	H34	32.	BV32	32.	LS31
33.	B33	33.	H35	33.	BV33	33.	LS32
34.	B34	34.	H36a	34.	BV34	34.	LS33
35.	B35	35.	H37	35.	BV35	35.	LS34
36.	B36	36.	H38	36.	BV36	36.	LS35
37.	B37	37.	H39a	37.	BV37	37.	LS36a
38.	B38	38.	H48a	38.	BV38	38.	LS37
39.	B39	39.	H49	39.	BV39	39.	LS38
40.	B40	40.	H39b	40.	BV40	40.	LS39
41.	B41	41.	H39c	41.	BV41	41.	LS40
42.	B42	42.	H40a	42.	BV42	42.	LS41
43.	B43	43.	H47a	43.	BV43	43.	LS42
44.	B44	44.	H43a	44.	BV44	44.	LS43a
45.	B45	45.	H41a	45.	BV45	45.	LS44
46.	B46	46.	H42a	46.	BV46	46.	LS45

Blood		The Heart		Blood Vessels		The Lymphatic System	
47.	B47a	47.	H42b	47.	BV47	47.	LS46
48.	B48	48.	H42c	48.	BV48	48.	LS47
49.	B49a	49.	H43b	49.	BV49	49.	LS48
50.	B50	50.	H44a	50.	BV50	50.	LS49
51.	B51	51.	H45a	51.	BV51	51.	LS50
52.	B52	52.	H46a	52.	BV52	52.	LS51
53.	B53	53.	H42d	53.	BV53	53.	LS52
54.	B54	54.	H50a	54.	BV54	54.	LS53
55.	B55a	55.	H50b	55.	BV55	55.	LS54
56.	B56	56.	H50c	56.	BV56a	56.	LS55
57.	B57	57.	H52a	57.	BV56b	57.	LS56
58.	B59	58.	H52b	58.	BV57	58.	LS57
59.	B60a	59.	H52c	59.	BV58	59.	LS58
60.	B61a	60.	H52d	60.	BV59	60.	LS59
61.	B62	61.	H52e	61.	BV60	61.	LS60
62.	B63	62.	H52f	62.	BV61	62.	LS61
63.	B64a	63.	H52g	63.	BV62	63.	LS62
64.	B65	64.	H52h	64.	BV63	64.	LS63
65.	B66	65.	H52i	65.	BV64	65.	LS64
66.	B67	66.	H52j	66.	BV65	66.	LS65
67.	B68	67.	H52k	67.	BV66	67.	LS66
68.	B69	68.	H55	68.	BV67	68.	LS67
69.	B70	69.	H56	69.	BV68	69.	LS68
70.	B71	70.	H57	70.	BV69	70.	LS69
71.	B72	71.	H58	71.	BV70	71.	LS70
72.	B73	72.	H59	72.	BV71	72.	LS71
73.	B74	73.	H60	73.	BV72	73.	LS72
74.	B75	74.	H61	74.	BV73	74.	LS73
75.	B76	75.	H62	75.	BV74	75.	LS74
76.	B77	76.	H63	76.	BV75	76.	LS75
77.	B78	77.	H64	77.	BV76	77.	LS76
78.	B79	78.	H65	78.	BV77	78.	LS77
79.	B80	79.	H66	79.	BV78	79.	LS78
80.	B81a	80.	H67	80.	BV79	80.	LS79
81.	B82	81.	H68	81.	BV80	81.	LS80
82.	B83	82.	H69	82.	BV81	82.	LS81
83.	B84a	83.	H70	83.	BV82	83.	LS82
84.	B85	84.	H71	84.	BV83	84.	LS83
85.	B86	85.	H72	85.	BV84	85.	LS84
86.	B87	86.	H73	86.	BV85	86.	LS85
87.	B88	87.	H74	87.	BV86		
88.	B89	88.	H75	88.	BV87		
89.	B90	89.	H76	89.	BV88		
90.	B91	90.	H77	90.	BV89		
91.	B92	91.	H78	91.	BV90		
92.	B93	92.	H79	92.	BV91		

Blood		The Heart		Blood Vessels		The Lymphatic System
93.	B94	93.	H80	93.	BV92	
94.	B95	94.	H81	94.	BV93	
95.	B97	95.	H82	95.	BV94	
96.	B98	96.	H83	96.	BV95	
97.	B99	97.	H84	97.	BV96	
98.	B100	98.	H85	98.	BV97	
99.	B101	99.	H86	99.	BV98	
100.	B102	100.	H88	100.	BV99	
101.	B103	101.	H89a	101.	BV100	
102.	B104	102.	H90	102.	BV101	
103.	B105	103.	H91a	103.	BV102	
104.	B106	104.	H92	104.	BV103	
105.	B107	105.	H93	105.	BV104	
106.	B108	106.	H94	106.	BV105	
107.	B109	107.	H87	107.	BV106	
108.	B110	108.	H96	108.	BV107	
109.	B111	109.	H97a	109.	BV108	
110.	B112	110.	H98a	110.	BV109	
111.	B113a	111.	H99a	111.	BV110	
112.	B114	112.	H100	112.	BV111	
113.	B115	113.	H101	113.	BV112	
114.	B116a	114.	H102	114.	BV113	
115.	B117	115.	H103a	115.	BV114	
116.	B118	116.	H104a	116.	BV115	
117.	B119	117.	H105	117.	BV116	
118.	B120a	118.	H106	118.	BV117	
119.	B121	119.	H107	119.	BV118	
120.	B122	120.	H108	120.	BV119	
121.	B123a	121.	H109	121.	BV120	
122.	B124	122.	H110	122.	BV121	
123.	B125	123.	H111	123.	BV122	
124.	B126	124.	H112a	124.	BV123	
125.	B127	125.	H113	125.	BV124	
126.	B128	126.	H114	126.	BV125	
		127.	H115	127.	BV126	
		128.	H116	128.	BV127	
		129.	H117	129.	BV128	
		130.	H118a	130.	BV129	
		131.	H119	131.	BV130	
		132.	H120	132.	BV131	
		133.	H121	133.	BV132	
		134.	H122	134.	BV133	
		135.	H123	135.	BV134	
		136.	H124	136.	BV135	
		137.	H125	137.	BV136	
		138.	H126a	138.	BV137	

Blood	The Heart		Blood Vessels		The Lymphatic System
	139.	H127	139.	BV138	
	140.	H128	140.	BV139	
	141.	H129	141.	BV140	
	142.	H130	142.	BV141	
	143.	H131	143.	BV142	
	144.	H132	144.	BV143	
	145.	H133	145.	BV144	
	146.	H134a	146.	BV145	
	147.	H135	147.	BV146	
	148.	H136	148.	BV147	
	149.	H137	149.	BV148	
	150.	H138a	150.	BV149	
	151.	H139	151.	BV150	
	152.	H140	152.	BV151	
	153.	H141	153.	BV152	
	154.	H142	154.	BV152a	
	155.	H143	155.	BV153	
	156.	H144	156.	BV154	
	157.	H145	157.	BV155	
	158.	H146	158.	BV156	
	159.	H147	159.	BV157	
	160.	H148	160.	BV158	
	161.	H149	161.	BV159	
	162.	H150	162.	BV162	
	163.	H151	163.	BV163	
	164.	H152	164.	BV165	
	165.	H153	165.	BV166	
	166.	H154	166.	BV167	
	167.	H155	167.	BV168	
	168.	H156	168.	BV169	
	169.	H157	169.	BV170	
	170.	H158a	170.	BV171	
	171.	H159	171.	BV172	
	172.	H160	172.	BV173	
	173.	H161	173.	BV174	
	174.	H162	174.	BV175	
	175.	H163	175.	BV176	
	176.	H164	176.	BV177	
	177.	H165	177.	BV178	
	178.	H166	178.	BV179	
	179.	H167	179.	BV180	
	180.	H168	180.	BV181	
	181.	H169	181.	BV182	
	182.	H170	182.	BV183	
	183.	H171	183.	BV184	
	184.	H172	184.	BV185	

Blood	The Heart		Blood Vessels		The Lymphatic System
	185.	H173	185.	BV186	
	186.	H174	186.	BV187	
	187.	H175	187.	BV188	
	188.	H176	188.	BV189	
	189.	H177a	189.	BV190	
	190.	H178	190.	BV191	
	191.	H179	191.	BV192	
	192.	H180	192.	BV193	
	193.	H181	193.	BV194	
	194.	H182	194.	BV195	
	195.	H183	195.	BV196	
	196.	H184	196.	BV197	
	197.	H185	197.	BV198	
	198.	H186	198.	BV199	
	199.	H187	199.	BV200	
	200.	H188	200.	BV201	
	201.	H189	201.	BV202	
	202.	H190	202.	BV203	
	203.	H191	203.	BV204	
	204.	H192	204.	BV205	
	205.	H193	205.	BV206	
	206.	H194	206.	BV207	
	207.	H195	207.	BV208	
	208.	H196	208.	BV209a	
	209.	H197	209.	BV210	
	210.	H198	210.	BV211	
	211.	H199	211.	BV212	
	212.	H200	212.	BV213	
	213.	H201	213.	BV214	
	214.	H53	214.	BV215	
	215.	H54	215.	BV216a	
	216.	H202	216.	BV217	
	217.	H203a	217.	BV218	
	218.	H203b	218.	BV219	
	219.	H204	219.	BV220	
	220.	H205	220.	BV221	
	221.	H206	221.	BV222	
	222.	H207	222.	BV223	
	223.	H208	223.	BV224	
	224.	H209	224.	BV225a	
	225.	H210	225.	BV226	
	226.	H211	226.	BV227	
	227.	H212	227.	BV228	
	228.	H213	228.	BV229	
	229.	H214	229.	BV230	
	230.	H215	230.	BV231	

Appendix 1

The Immune System		The Respiratory System		Digestive System - Anatomy		Digestive System - Physiology	
1.	IS1	1.	RS1	1.	DSGA1	1.	DSP1
2.	IS2	2.	RS2	2.	DSGA2	2.	DSP2
3.	IS3a	3.	RS3	3.	DSGA3	3.	DSP3
4.	IS4	4.	RS4	4.	DSGA4	4.	DSP4
5.	IS5	5.	RS5	5.	DSGA5	5.	DSP5
6.	IS6	6.	RS6	6.	DSGA6	6.	DSP6
7.	IS7	7.	RS7	7.	DSGA7	7.	DSP7
8.	IS8	8.	RS8	8.	DSGA8	8.	DSP8
9.	IS9	9.	RS9	9.	DSGA9	9.	DSP9
10.	IS10a	10.	RS10	10.	DSGA10	10.	DSP10
11.	IS11	11.	RS11a	11.	DSGA11	11.	DSP11
12.	IS12	12.	RS12a	12.	DSGA12	12.	DSP12
13.	IS13	13.	RS13	13.	DSGA13	13.	DSP13
14.	IS13b	14.	RS14	14.	DSGA14	14.	DSP14
15.	IS13c	15.	RS15a	15.	DSGA15	15.	DSP15
16.	IS13a	16.	RS16	16.	DSGA16	16.	DSP16
17.	IS14	17.	RS17	17.	DSGA17	17.	DSP17
18.	IS15	18.	RS18	18.	DSGA18	18.	DSP18
19.	IS16	19.	RS19	19.	DSGA19	19.	DSP19
20.	IS17	20.	RS20	20.	DSGA20	20.	DSP20
21.	IS18	21.	RS21	21.	DSGA21	21.	DSP21
22.	IS19	22.	RS22	22.	DSGA22	22.	DSP22a
23.	IS20	23.	RS23	23.	DSGA23	23.	DSP23
24.	IS21	24.	RS24	24.	DSGA24	24.	DSP24
25.	IS22	25.	RS25	25.	DSGA25	25.	DSP25
26.	IS23a	26.	RS26	26.	DSGA26	26.	DSP26
27.	IS24	27.	RS27	27.	DSGA27	27.	DSP27
28.	IS25	28.	RS28	28.	DSGA28	28.	DSP28
29.	IS26	29.	RS29	29.	DSGA29	29.	DSP29
30.	IS27	30.	RS30	30.	DSGA30	30.	DSP30
31.	IS28	31.	RS31	31.	DSGA31	31.	DSP31
32.	IS29	32.	RS32	32.	DSGA32	32.	DSP32
33.	IS30	33.	RS33	33.	DSGA33	33.	DSP33
34.	IS31	34.	RS34	34.	DSGA34	34.	DSP34
35.	IS32	35.	RS35	35.	DSGA35	35.	DSP35
36.	IS33	36.	RS36	36.	DSGA36	36.	DSP36
37.	IS33a	37.	RS37	37.	DSGA37	37.	DSP37
38.	IS34	38.	RS38	38.	DSGA38	38.	DSP38
39.	IS34a	39.	RS39	39.	DSGA39	39.	DSP39
40.	IS35	40.	RS40	40.	DSGA40	40.	DSP40
41.	IS35a	41.	RS41a	41.	DSGA41	41.	DSP41
42.	IS35b	42.	RS42a	42.	DSGA42	42.	DSP42
43.	IS35c	43.	RS43	43.	DSGA43	43.	DSP43
44.	IS35d	44.	RS44	44.	DSGA44a	44.	DSP44
45.	IS35e	45.	RS45	45.	DSGA45	45.	DSP45
46.	IS36	46.	RS46	46.	DSGA46	46.	DSP46

Appendix 1

The Immune System		The Respiratory System		Digestive System - Anatomy		Digestive System - Physiology	
47.	IS37a	47.	RS47	47.	DSGA47	47.	DSP47
48.	IS38	48.	RS48	48.	DSGA48	48.	DSP48
49.	IS39	49.	RS49	49.	DSGA49	49.	DSP49
50.	IS40	50.	RS50	50.	DSGA50	50.	DSP50
51.	IS41	51.	RS51	51.	DSGA51	51.	DSP51
52.	IS42	52.	RS52	52.	DSGA52	52.	DSP52
53.	IS43	53.	RS53	53.	DSGA53	53.	DSP53
54.	IS44	54.	RS54	54.	DSGA54	54.	DSP54
55.	IS45	55.	RS55	55.	DSGA55	55.	DSP55
56.	IS46	56.	RS56	56.	DSGA56	56.	DSP56
57.	IS47	57.	RS57	57.	DSGA57	57.	DSP57
58.	IS48a	58.	RS58	58.	DSGA58	58.	DSP58
59.	IS49	59.	RS59	59.	DSGA59	59.	DSP59
60.	IS50	60.	RS60	60.	DSGA60	60.	DSP60
61.	IS51a	61.	RS61	61.	DSGA61	61.	DSP61
62.	IS52	62.	RS62	62.	DSGA62	62.	DSP62
63.	IS53	63.	RS63	63.	DSGA63	63.	DSP63
64.	IS54	64.	RS64	64.	DSGA64	64.	DSP64
65.	IS55	65.	RS65a	65.	DSGA65	65.	DSP65
66.	IS56	66.	RS66a	66.	DSGA66	66.	DSP66
67.	IS57a	67.	RS67	67.	DSGA67	67.	DSP67
68.	IS58	68.	RS68	68.	DSGA68	68.	DSP68a
69.	IS59	69.	RS69	69.	DSGA69	69.	DSP69
70.	IS60	70.	RS70	70.	DSGA70	70.	DSP70
71.	IS61	71.	RS71	71.	DSGA71	71.	DSP71
72.	IS62	72.	RS72	72.	DSGA72	72.	DSP72
73.	IS63	73.	RS73	73.	DSGA73	73.	DSP73
74.	IS64	74.	RS74	74.	DSGA74a	74.	DSP74
75.	IS65	75.	RS75	75.	DSGA75	75.	DSP75
76.	IS66a	76.	RS76	76.	DSGA76	76.	DSP76
77.	IS67a	77.	RS77	77.	DSGA77	77.	DSP77
78.	IS68	78.	RS78	78.	DSGA78a	78.	DSP78
79.	IS69	79.	RS79	79.	DSGA79a	79.	DSP79
80.	IS70	80.	RS80	80.	DSGA80	80.	DSP80
81.	IS71a	81.	RS81			81.	DSP81
82.	IS72	82.	RS82			82.	DSP82
83.	IS73	83.	RS83			83.	DSP83
84.	IS74	84.	RS84			84.	DSP84
85.	IS75	85.	RS85			85.	DSP85
86.	IS76	86.	RS86			86.	DSP86
87.	IS77	87.	RS87			87.	DSP87
88.	IS78	88.	RS88			88.	DSP88
89.	IS79	89.	RS89			89.	DSP89
90.	IS80	90.	RS90			90.	DSP90
91.	IS81	91.	RS91			91.	DSP91
92.	IS82	92.	RS92			92.	DSP92

Appendix 1

The Immune System		The Respiratory System		Digestive System - Anatomy	Digestive System - Physiology	
93.	IS83	93.	RS93		93.	DSP93
94.	IS84	94.	RS94		94.	DSP94
95.	IS85	95.	RS95		95.	DSP95
96.	IS86	96.	RS96		96.	DSP96
97.	IS87	97.	RS97		97.	DSP97
98.	IS88	98.	RS98		98.	DSP98
99.	IS89	99.	RS99		99.	DSP99
100.	IS90a	100.	RS100		100.	DSP100
101.	IS91a	101.	RS101		101.	DSP101
102.	IS92	102.	RS102		102.	DSP102
103.	IS92a	103.	RS103		103.	DSP103
104.	IS93	104.	RS104		104.	DSP104
105.	IS94	105.	RS105		105.	DSP105
106.	IS95	106.	RS106		106.	DSP106
107.	IS96	107.	RS107		107.	DSP107
108.	IS97	108.	RS108a		108.	DSP108
109.	IS98	109.	RS109		109.	DSP109
110.	IS99	110.	RS110		110.	DSP110
111.	IS100	111.	RS111		111.	DSP111
112.	IS101	112.	RS112		112.	DSP112
113.	IS102	113.	RS113		113.	DSP113
114.	IS103	114.	RS113b		114.	DSP114
115.	IS104	115.	RS114		115.	DSP115
116.	IS105	116.	RS115		116.	DSP115a
117.	IS106	117.	RS116		117.	DSP115b
118.	IS107	118.	RS117		118.	DSP115c
119.	IS108	119.	RS118		119.	DSP115d
120.	IS109	120.	RS119		120.	DSP116
121.	IS110	121.	RS120		121.	DSP117
122.	IS111	122.	RS121		122.	DSP118
		123.	RS122		123.	DSP119
		124.	RS123		124.	DSP120
		125.	RS124		125.	DSP121
		126.	RS125		126.	DSP121a
		127.	RS126		127.	DSP122
		128.	RS127		128.	DSP123
		129.	RS128		129.	DSP124
		130.	RS129		130.	DSP125
		131.	RS130		131.	DSP126
		132.	RS131		132.	DSP127
		133.	RS132		133.	DSP128
		134.	RS133		134.	DSP129
		135.	RS134		135.	DSP130a
		136.	RS135		136.	DSP131a
		137.	RS136		137.	DSP132
		138.	RS137		138.	DSP133

The Immune System	The Respiratory System	Digestive System - Anatomy	Digestive System - Physiology
	139. RS138		139. DSP134
	140. RS139		140. DSP135
	141. RS140		141. DSP136
	142. RS141		142. DSP137
	143. RS142		143. DSP138
	144. RS143		144. DSP139
	145. RS144		145. DSP140
	146. RS145		146. DSP141a
	147. RS146		147. DSP142
	148. RS147		148. DSP143
	149. RS148		149. DSP144
	150. RS149		150. DSP145
	151. RS150		151. DSP146
	152. RS151		152. DSP147
	153. RS152		153. DSP148
	154. RS153		154. DSP149
	155. RS154		155. DSP150
	156. RS155		156. DSP151
	157. RS156		157. DSP152
	158. RS157		158. DSP153
	159. RS158		159. DSP154
	160. RS159		160. DSP155
	161. RS160		161. DSP156
	162. RS161		162. DSP157
	163. RS162		163. DSP158
	164. RS163		164. DSP159
	165. RS164		165. DSP160
	166. RS165		166. DSP161
	167. RS166a		167. DSP162
	168. RS167		168. DSP163a
	169. RS168		169. DSP164
	170. RS169a		170. DSP165
	171. RS170		171. DSP166
	172. RS171a		172. DSP167
	173. RS172		173. DSP168
	174. RS173		174. DSP169
	175. RS174		175. DSP170
	176. RS175		176. DSP171
	177. RS176		177. DSP172
	178. RS177		178. DSP173
			179. DSP174
			180. DSP175
			181. DSP176
			182. DSP177
			183. DSP178
			184. DSP179

Appendix 1

Nutrition		Metabolism		The Urinary System		Fluid & Electrolytes	
1.	N1	1.	M1	1.	US1	1.	FE1
2.	N2	2.	M2	2.	US2	2.	FE2
3.	N3	3.	M3	3.	US3	3.	FE3
4.	N4	4.	M4	4.	US4	4.	FE4
5.	N5	5.	M5	5.	US5	5.	FE5
6.	N6	6.	M6	6.	US6	6.	FE6
7.	N7	7.	M7a	7.	US7	7.	FE7
8.	N8	8.	M8	8.	US8	8.	FE8
9.	N9	9.	M9	9.	US9	9.	FE9
10.	N10	10.	M10	10.	US10a	10.	FE10
11.	N11	11.	M11	11.	US11	11.	FE11
12.	N12	12.	M12	12.	US12	12.	FE12
13.	N13	13.	M13	13.	US13	13.	FE13
14.	N14	14.	M14	14.	US14	14.	FE14
15.	N15	15.	M15	15.	US15	15.	FE15
16.	N16	16.	M16	16.	US16	16.	FE16
17.	N17	17.	M17	17.	US17	17.	FE17
18.	N18	18.	M18	18.	US18	18.	FE18
19.	N19	19.	M19	19.	US19	19.	FE19
20.	N20	20.	M20	20.	US20	20.	FE20
21.	N21	21.	M21	21.	US21	21.	FE21
22.	N22	22.	M22	22.	US22	22.	FE22
23.	N23	23.	M23	23.	US23	23.	FE23
24.	N24	24.	M24	24.	US24	24.	FE24
25.	N25	25.	M25	25.	US25	25.	FE25
26.	N26	26.	M26	26.	US26	26.	FE26
27.	N27	27.	M27a	27.	US27	27.	FE27
28.	N27a	28.	M28	28.	US28	28.	FE28
29.	N27b	29.	M29a	29.	US29	29.	FE29
30.	N28	30.	M30a	30.	US30	30.	FE30
31.	N29	31.	M30b	31.	US31	31.	FE31
32.	N30	32.	M31a	32.	US32	32.	FE32
33.	N31	33.	M32a	33.	US33	33.	FE33
34.	N32	34.	M33	34.	US34	34.	FE34
35.	N33	35.	M34	35.	US35	35.	FE35
36.	N34	36.	M35	36.	US36	36.	FE36
37.	N35	37.	M36	37.	US37	37.	FE37
38.	N36	38.	M37a	38.	US38	38.	FE38
39.	N37	39.	M38a	39.	US39	39.	FE39
40.	N38	40.	M39	40.	US40a	40.	FE40
41.	N39	41.	M40	41.	US41	41.	FE41
42.	N40	42.	M41	42.	US42	42.	FE42
43.	N41	43.	M42	43.	US43	43.	FE43
44.	N42	44.	M43	44.	US44	44.	FE44
45.	N43	45.	M44	45.	US45	45.	FE45
46.	N44	46.	M45	46.	US46	46.	FE46

Appendix 1

Nutrition		Metabolism		The Urinary System		Fluid & Electrolytes	
47.	N45	47.	M46a	47.	US47	47.	FE47
48.	N46	48.	M47	48.	US48	48.	FE48
49.	N47	49.	M48	49.	US49	49.	FE49
50.	N48	50.	M49	50.	US50	50.	FE50
51.	N49	51.	M50	51.	US51	51.	FE51
52.	N50	52.	M51	52.	US52	52.	FE52
53.	N51	53.	M52a	53.	US53	53.	FE53
54.	N52	54.	M54	54.	US54	54.	FE54
55.	N53	55.	M55	55.	US55	55.	FE55
56.	N54a	56.	M56	56.	US56	56.	FE56
57.	N55	57.	M57	57.	US57	57.	FE57
58.	N56	58.	M58	58.	US58	58.	FE58
59.	N57	59.	M59	59.	US59	59.	FE59
60.	N58	60.	M60	60.	US60	60.	FE60
61.	N59	61.	M61	61.	US61	61.	FE61
62.	N60	62.	M62	62.	US62	62.	FE61a
63.	N61	63.	M63	63.	US63	63.	FE62
64.	N62	64.	M64	64.	US64	64.	FE63
65.	N63			65.	US65	65.	FE64
66.	N64			66.	US66		
67.	N65			67.	US67		
68.	N66			68.	US68		
69.	N67			69.	US69		
70.	N68			70.	US70a		
71.	N69a			71.	US71		
72.	N70			72.	US72		
73.	N71			73.	US73		
74.	N72			74.	US74		
75.	N73			75.	US75		
76.	N74a			76.	US76		
77.	N75			77.	US77		
78.	N76			78.	US78		
79.	N77			79.	US79		
80.	N78			80.	US80		
81.	N79			81.	US81		
82.	N80			82.	US82		
83.	N81a			83.	US83		
84.	N82			84.	US84a		
85.	N83			85.	US85		
86.	N84a			86.	US86		
87.	N85			87.	US87		
88.	N86a			88.	US88		
89.	N87a			89.	US89		
90.	N88			90.	US90		
91.	N89a			91.	US91		
92.	N90a			92.	US92		

Nutrition		Metabolism	The Urinary System		Fluid & Electrolytes
93.	N91a		93.	US93	
			94.	US94	
			95.	US95	
			96.	US96	
			97.	US97	
			98.	US98	
			99.	US99	
			100.	US100	
			101.	US101	
			102.	US102	
			103.	US103	
			104.	US104	
			105.	US105	
			106.	US106	
			107.	US107	
			108.	US108	
			109.	US109	
			110.	US110	
			111.	US111	
			112.	US112	
			113.	US113a	
			114.	US114	
			115.	US115	
			116.	US116	
			117.	US117	
			118.	US118	
			119.	US119	
			120.	US120	
			121.	US121	
			122.	US122	
			123.	US123	
			124.	US124b	
			125.	US125	
			126.	US126	
			127.	US127	
			128.	US128	
			129.	US129	
			130.	US130	
			131.	US131	
			132.	US132a	
			133.	US133a	
			134.	US134	
			135.	US135	
			136.	US136	
			137.	US137	
			138.	US138	

Appendix 1

Nutrition	Metabolism	The Urinary System	Fluid & Electrolytes
		139. US139a	
		140. US140	
		141. US141	
		142. US142	
		143. US143	
		144. US144	
		145. US145	
		146. US146	
		147. US147	
		148. US148	
		149. US149	
		150. US150	
		151. US151	
		152. US152	
		153. US153	
		154. US154	
		155. US155	
		156. US156	
		157. US157	
		158. US158	
		159. US159	
		160. US160	
		161. US161	
		162. US162	
		163. US163	
		164. US164a	
		165. US164b	
		166. US164c	
		167. US165a	
		168. US166	

Appendix 1

pH		Meiosis Review		Male Reproductive System		Female Reproductive System	
1.	pH1	1.	MR1	1.	MRS1	1.	FRS1
2.	pH2	2.	MR2	2.	MRS2	2.	FRS2
3.	pH3	3.	MR3	3.	MRS3	3.	FRS3
4.	pH4	4.	MR4	4.	MRS4	4.	FRS4
5.	pH5	5.	MR5	5.	MRS5	5.	FRS5
6.	pH6	6.	MR6	6.	MRS6	6.	FRS6
7.	pH7	7.	MR7	7.	MRS7	7.	FRS7
8.	pH8	8.	MR8	8.	MRS8	8.	FRS8
9.	pH9	9.	MR9	9.	MRS9	9.	FRS9
10.	pH10	10.	MR10	10.	MRS10	10.	FRS9a
11.	pH11	11.	MR11	11.	MRS11	11.	FRS10
12.	pH12			12.	MRS12	12.	FRS10a
13.	pH13			13.	MRS13	13.	FRS10b
14.	pH14			14.	MRS14	14.	FRS10c
15.	pH15			15.	MRS15	15.	FRS14
16.	pH16			16.	MRS16	16.	FRS15
17.	pH17			17.	MRS17	17.	FRS15a
18.	pH18			18.	MRS18	18.	FRS15b
19.	pH19			19.	MRS19	19.	FRS15c
20.	pH20			20.	MRS20	20.	FRS15d
21.	pH21			21.	MRS21	21.	FRS13
22.	pH22			22.	MRS22	22.	FRS16
23.	pH23			23.	MRS23	23.	FRS17
24.	pH24			24.	MRS24	24.	FRS18a
25.	pH25			25.	MRS25	25.	FRS19
26.	pH26			26.	MRS26	26.	FRS20
27.	pH27			27.	MRS27	27.	FRS21
28.	pH28			28.	MRS28	28.	FRS22
29.	pH29			29.	MRS29	29.	FRS23a
30.	pH30			30.	MRS30	30.	FRS24
31.	pH31			31.	MRS31	31.	FRS25a
32.	pH32			32.	MRS32	32.	FRS26
33.	pH33			33.	MRS33	33.	FRS27
34.	pH34			34.	MRS34a	34.	FRS28
35.	pH35			35.	MRS35	35.	FRS29
36.	pH36			36.	MRS36	36.	FRS30
37.	pH37			37.	MRS37	37.	FRS31
38.	pH38			38.	MRS38	38.	FRS32
39.	pH39			39.	MRS39	39.	FRS33
40.	pH40			40.	MRS40	40.	FRS34a
41.	pH41			41.	MRS41	41.	FRS35
42.	pH42			42.	MRS42	42.	FRS36
43.	pH43			43.	MRS43	43.	FRS37
44.	pH44			44.	MRS44	44.	FRS38
45.	pH45			45.	MRS45	45.	FRS39
46.	pH46			46.	MRS46	46.	FRS40

pH		Meiosis Review	Male Reproductive System		Female Reproductive System	
47.	pH47		47.	MRS47	47.	FRS41
48.	pH48		48.	MRS48	48.	FRS42
49.	pH49		49.	MRS49	49.	FRS43
50.	pH50		50.	MRS50	50.	FRS44
51.	pH51		51.	MRS51	51.	FRS45
52.	pH52		52.	MRS52	52.	FRS46
			53.	MRS53	53.	FRS47
			54.	MRS54	54.	FRS48
			55.	MRS55	55.	FRS49
			56.	MRS56	56.	FRS50
			57.	MRS57	57.	FRS51
					58.	FRS52
					59.	FRS53
					60.	FRS54
					61.	FRS55
					62.	FRS56
					63.	FRS57a
					64.	FRS58
					65.	FRS59
					66.	FRS60
					67.	FRS61
					68.	FRS62
					69.	FRS63
					70.	FRS64
					71.	FRS65
					72.	FRS66
					73.	FRS67
					74.	FRS68
					75.	FRS69
					76.	FRS70
					77.	FRS71
					78.	FRS72
					79.	FRS73
					80.	FRS74
					81.	FRS75
					82.	FRS76
					83.	FRS77

Reproduction	
1.	R1
2.	R2
3.	R3
4.	R4
5.	R5
6.	R6
7.	R7
8.	R8
9.	R9
10.	R10
11.	R11
12.	R12
13.	R13
14.	R14
15.	R15
16.	R16
17.	R17
18.	R18
19.	R19
20.	R20
21.	R21
22.	R22
23.	R23
24.	R24
25.	R25
26.	R26
27.	R27
28.	R28
29.	R29
30.	R30
31.	R31
32.	R32
33.	R33
34.	R34
35.	R35
36.	R36
37.	R37
38.	R38
39.	R39
40.	R40
41.	R41
42.	R42
43.	R43
44.	R44
45.	R45
46.	R46

Reproduction	
47.	R47
48.	R48
49.	R49
50.	R50
51.	R51a
52.	R52
53.	R53
54.	R54
55.	R55
56.	R56
57.	R57
58.	R58
59.	R59
60.	R60
61.	R61
62.	R62
63.	R63
64.	R64
65.	R64a
66.	R65
67.	R66
68.	R67
69.	R68
70.	R69
71.	R70
72.	R71
73.	R72
74.	R73
75.	R74
76.	R75
77.	R76
78.	R77
79.	R78
80.	R79
81.	R80
82.	R81
83.	R82
84.	R83
85.	R84
86.	R85
87.	R86
88.	R87

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