MULTIPLE CHOICE

1. Indicators that an individual is experiencing high stress include all the following *except*
   a. tachycardia.
   b. diaphoresis.
   c. increased peripheral resistance.
   d. pupil constriction.

   ANS: D
   Pupils dilate during stress from the effects of catecholamines. Tachycardia, diaphoresis, and increased peripheral resistance are indicators of stress and also occur because of catecholamine release.

2. Which is *not* normally secreted in response to stress?
   a. Norepinephrine
   b. Cortisol
   c. Epinephrine
   d. Insulin

   ANS: D
   Insulin secretion is impaired during stress to promote energy from increased blood glucose. Norepinephrine is secreted during stress as a mediator of stress and adaptation. Cortisol is secreted during stress as a mediator of stress and adaptation and stimulates gluconeogenesis in the liver to supply the body with glucose. Epinephrine is secreted during stress as a mediator of stress and adaptation and increases glycogenolysis and the release of glucose from the liver.

3. Selye's three phases of the stress response include all the following *except*
   a. allostasis.
   b. resistance.
   c. alarm.
   d. exhaustion.

   ANS: A
   Allostasis is defined as the ability to successfully adapt to challenges. Allostasis may/may not occur in response to stress. Alarm, resistance, and exhaustion are the three phases of the stress response as described by Selye in the general adaptation syndrome.

4. Many of the responses to stress are attributed to activation of the sympathetic nervous system and are mediated by
   a. norepinephrine.
   b. cortisol.
   c. glucagon.
   d. ACTH.

   ANS: A

Norepinephrine is secreted in response to activation of the sympathetic nervous system during stress by the adrenal medulla. Cortisol is secreted by the adrenal cortex. Glucagon is secreted by the pancreas. ACTH is secreted by the pituitary gland.

5. The effects of excessive cortisol production include
a. immune suppression.
b. hypoglycemia.
c. anorexia.
d. inflammatory reactions.

ANS: A
Cortisol suppresses immune function and inflammation and stimulates appetite. Cortisol leads to hyperglycemia by stimulating gluconeogenesis in the liver.

6. All the following stress-induced hormones increase blood glucose *except*
a. aldosterone.
b. cortisol.
c. norepinephrine.
d. epinephrine.

ANS: A
Aldosterone results in water and sodium retention and potassium loss in the urine. It does not affect blood glucose. Cortisol is a glucocorticoid secreted by the adrenal cortex. Cortisol stimulates gluconeogenesis in the liver, thus increasing blood glucose. Norepinephrine inhibits insulin secretion, thus increasing blood sugar. Epinephrine increases glucose release from the liver and inhibits insulin secretion, thus increasing blood glucose.

7. Allostasis is best defined as
a. steady-state.
b. a state of equilibrium, of balance within the organism.
c. the process by which the body heals following disease.
d. the overall process of adaptive change necessary to maintain survival and well-being.

ANS: D
Allostasis refers to the overall process of adaptive change necessary to maintain survival and well-being.

8. The primary adaptive purpose of the substances produced in the alarm stage is
a. energy and repair.
b. invoke resting state.
c. produce exhaustion.
d. set a new baseline steady-state.

ANS: A
These resources are used for energy and as building blocks, especially the amino acids, for the later growth and repair of the organism. The substances do not produce a resting state. The substances can produce exhaustion if they continue, but that is not the adaptive purpose of these. Although a new baseline steady-state may result from the stress response that is not the adaptive purpose of the substances produced during the alarm stage.

9. Persistence of the alarm stage will ultimately result in
   a. stress reduction.
   b. permanent damage and death.
   c. movement into the resistance stage.
   d. exhaustion of the sympathetic nervous system.

   ANS: B
   If the alarm stage were to persist, the body would soon suffer undue wear and tear and become subject to permanent damage and even death. Actions taken by the individual during the resistance stage lead to stress reduction. The resistance stage may or may not occur following the alarm stage, based on resource availability. The sympathetic nervous system will continue to function, resulting in continued release of stress hormones.

10. The effect of stress on the immune system
    a. is unknown.
    b. has been demonstrated to be non-existent in studies.
    c. most often involves enhancement of the immune system.
    d. may involve enhancement or impairment the immune system.

    ANS: D
    Many studies demonstrate that long-term stress impairs the immune system, but many researchers identify that short-term stress may enhance the immune system.

MULTIPLE RESPONSE

1. Aldosterone may increase during stress, leading to (*Select all that apply.*)
   a. decreased urinary output.
   b. increased blood potassium.
   c. increased sodium retention.
   d. increased blood volume.
   e. decreased blood pressure.

   ANS: A, C, D
   Aldosterone increases water and sodium reabsorption and potassium excretion by the renal distal tubules and collecting ducts, thus leading to decreased urinary output, sodium retention in the body, and increased extracellular fluid volume. Because it leads to potassium excretion, aldosterone leads to decreased blood potassium.

2. Chronic activation of stress hormones can lead to (*Select all that apply.*)
   a. cardiovascular disease.
   b. depression.
   c. impaired cognitive function.
   d. autoimmune disease.
   e. overactive immune function.

   ANS: A, B, C, D

Excessive cortisol levels promote hypertension, atherosclerosis, and the development of cardiovascular disease. Chronic overactive stress hormones may result in atrophy and death of brain cells. Elevated levels of stress hormones are found in individuals with depressive disorders. Chronic stress leads to immune function impairment, rather than overactive immune function, and has been implicated in autoimmune disorders.

3. Events which occur during the alarm stage of the stress response include secretion of (*Select all that apply.*)
   a. catecholamines.
   b. ACTH.
   c. glucocorticoids.
   d. immune cytokines.
   e. TSH.

   ANS: A, B, C, D
   During the alarm stage, catecholamines (epinephrine, norepinephrine), ACTH, glucocorticoids, and immune cytokines are secreted. TSH is not secreted during the stress response.

MULTIPLE CHOICE

1. Glycolysis is the metabolic process of breaking down a glucose molecule to form
   a. CO_2 and H_2O.
   b. 2 ATP and 2 pyruvate.
   c. 30 ATP.
   d. oxygen.

   ANS: B
   Glycolysis produces a net gain of two ATP molecules and breaks down glucose modules to produce two pyruvate molecules. Oxidative phosphorylation produces CO_2 and H_2O. Oxidative phosphorylation produces 30 ATP molecules. Oxygen is not produced by glycolysis, but it is necessary for oxidative phosphorylation.

2. The benefit of glycolysis is that this second stage of catabolism supplies
   a. ATP to meet energy needs of the body.
   b. pyruvate to the citric acid cycle.
   c. energy for oxidative phosphorylation.
   d. lactate during anaerobic conditions.

   ANS: B
   The benefit of glycolysis is to supply pyruvate to the citric acid cycle of cellular metabolism, which then produces much ATP. Glycolysis only produces two ATP modules, which is insufficient for energy needs. Glycolysis does not supply energy for oxidative phosphorylation. Lactate produced during prolonged anaerobic conditions builds up and can lead to lactic acidosis, which is an undesirable outcome.

3. Repolarization of a neuron after a depolarizing action potential is because of
   a. activation of the Na^+-K^+ pump.
   b. influx of calcium.
   c. efflux of potassium.
   d. influx of sodium.

   ANS: C
   Repolarization is because of efflux of potassium from the cell. The Na^+-K^+ pump maintains cellular volume via osmotic pressure and helps to maintain resting membrane potential. Calcium influx prolongs the action potential. Influx of sodium initiates depolarization.

4. Excitable cells are able to conduct action potentials because they have
   a. receptors for neurotransmitters.
   b. tight junctions.
   c. ligand-gated channels.
   d. voltage-gated channels.

   ANS: D

Voltage-gated channels respond to changes in membrane potential and are responsible for conducting action potentials. Receptors for neurotransmitters allow neurotransmitters to bind to the cell membrane but are not directly responsible for action potentials in excitable cells. Tight junctions are intercellular connections that help segregate proteins on the cell membrane and are not involved in conducting action potentials. Ligand-gated channels respond to binding of a signaling molecule such as a neurotransmitter, but are not directly responsible for action potentials in excitable cells.

5. The resting membrane potential in nerve and skeletal muscle is determined primarily by
   a. extracellular sodium ion concentration.
   b. the ratio of intracellular to extracellular potassium ions.
   c. activation of voltage-gated sodium channels.
   d. activity of energy-dependent membrane pumps.

   ANS: B
   The major determinant of the resting membrane potential is the difference in potassium ion concentration across the membrane. Extracellular sodium helps maintain cell volume and resting membrane potential, but it is not the primary determinant. Activation of voltage-gated sodium channels help initiate an action potential. Channels are not linked to an energy source; ions flow passively across the cell membrane.

6. An increase in extracellular potassium ion from 4.0 to 6.0 mEq/L would
   a. hyperpolarize the resting membrane potential.
   b. make it more difficult to reach threshold and produce an action potential.
   c. hypopolarize the resting membrane potential.
   d. alter the threshold potential.

   ANS: C
   An increase in extracellular potassium hypopolarizes the cell (makes it less negative) because more K^+ ions stay inside the cell owing to the reduced concentration gradient. Hyperpolarization of the resting membrane potential (makes it more negative) is caused by a decrease in extracellular potassium. Hyperpolarization resulting from a decrease in extracellular potassium makes it more difficult to reach threshold and produce an action potential. The threshold for action potential does not change with a change in extracellular potassium.

7. GTP-binding proteins (G-proteins) function to
   a. activate receptors on the extracellular surface.
   b. degrade second-messenger molecules.
   c. activate intracellular enzyme systems.
   d. synthesize ATP.

   ANS: C
   G-proteins activate specific target enzymes within the cell and these enzymes then produce second-messenger molecules that trigger specific intracellular function. Membrane-bound G-protein channels are a component of the cell membrane; they do not activate other receptors on the extracellular surface. G-proteins do not degrade second messengers, but instead produce these. G-proteins do not synthesize ATP.

8. Phospholipids spontaneously form lipid bilayers, because they are

a. polar.
b. charged.
c. insoluble.
d. amphipathic.

ANS: D
Phospholipids have a hydrophilic (water-loving) polar end and a hydrophobic (water-fearing) polar end. This amphipathic nature causes the lipids to form bilayers. It is the water-loving and water-fearing nature of the end rather than simply being polar, charged, or insoluble that forms the bilayers.

9. Cell-to-cell communication through secretion of chemical signals into the bloodstream to target cells throughout the body is called_____signaling.
a. synaptic
b. paracrine
c. endocrine
d. autocrine

ANS: C
Endocrine signaling is accomplished by specialized endocrine cells that secrete hormones that travel via the bloodstream to target cells throughout the body. Synaptic signaling occurs at specialized junctions between the nerve cell and its target cell; the neuron secretes a chemical neurotransmitter into a small space between the nerve and target cell. In paracrine signaling, chemicals are secreted into a localized area, and only those cells in the immediate area are affected. Autocrine signaling occurs when cells respond to signaling molecules that they secrete and provides feedback to that cell rather than other cells.

10. Ribosomes are very important organelles within the cell that have the function of
a. detoxifying substances.
b. synthesizing proteins.
c. converting energy to forms that can be used.
d. coding for protein synthesis.

ANS: B
Ribosome's primary function is the synthesis of proteins. Lysosomes and peroxisomes detoxify substances. Mitochondria convert energy to forms that can be used to drive cell reactions. The nucleus contains genomic DNA that codes for protein synthesis.

11. The cardiac drug digitalis enhances myocardial contraction, because it
a. increases intracellular calcium level in cardiac cells.
b. inhibits sodium from entering cardiac cells.
c. enhances the sodium–potassium pump.
d. increases the sodium gradient across the cell membrane.

ANS: A
Digitalis inhibits the sodium–potassium pump and allows the accumulation of intracellular sodium, decreasing the sodium gradient across the cell membrane. This leads to less efficient calcium removal by the sodium-dependent calcium pump. Increased calcium inside the cardiac cell leads to more forceful cardiac muscle contraction to treat congestive heart failure caused by cardiac muscle weakness.

12. The organelle that contains enzymes necessary for oxidative phosphorylation to produce ATP is the
    a. mitochondria.
    b. ribosome.
    c. lysosome.
    d. nucleus.

    ANS: A
    The inner membrane of the mitochondria contains many enzymes that promote oxidative phosphorylation which produces ATP. Ribosomes synthesize proteins. Lysosomes and peroxisomes detoxify substances. The nucleus contains genomic DNA that codes for protein synthesis.

13. Ion channels open and close in response to all the following *except*
    a. mechanical pressure.
    b. ligand binding.
    c. voltage changes.
    d. temperature changes.

    ANS: D
    No temperature change channels are present on the cell membrane. Mechanically gated channels respond to mechanical deformation. Ligand-gated channels respond to the binding of a signaling molecule (neurotransmitter or hormone). Voltage-gated channels respond to a change in membrane potential.

14. Gap junctions are connecting channels that allow passage of small molecules from one cell to the next and are especially important for
    a. distance signaling.
    b. tissues requiring synchronized function.
    c. communication within a cell.
    d. passage of large molecules.

    ANS: B
    Gap junctions are especially important in tissues in which synchronized functions are required such as in cardiac muscle contraction. Gap junctions are channels between adjacent cells, not distant cells. Gap junctions function to promote communication not within a cell, but between adjacent cells. Gap junctions allow passage of small molecules, but not large molecules.

TRUE/FALSE

1. During conditions of prolonged insufficient oxygen availability (e.g., respiratory or cardiovascular disease) anaerobic glycolysis accumulated pyruvate can lead to lactic acidosis.

    ANS: T
    Pyruvate is converted to lactate and released into the blood stream, resulting in lactic acidosis.

2. The phase of cellular metabolism in which energy is released during breakdown of nutrient sources is anabolism.

   ANS: F
   Catabolism involves energy release via breakdown of nutrient sources such as glucose to provide ATP to the cell. In contrast, anabolism refers to energy-using processes that result in complex molecules such as fats.

3. Some individuals inherit a gene that results in dangerously high blood cholesterol caused by impaired endocytosis of low-density lipoproteins (LDLs).

   ANS: T
   The defective gene inhibits the synthesis of LDL protein receptors on the cell membrane. This impairs endocytosis of LDL. High levels of LDL in the blood predispose to atherosclerosis.

Chapter 04: Cell Injury, Aging, and Death
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MULTIPLE CHOICE

1. An increase in organ size and function caused by increased workload is termed
   a. atrophy.
   b. hypertrophy.
   c. metaplasia
   d. inflammation.

   ANS: B
   Increased function of an organ such as the heart or skeletal muscle results in organ hypertrophy because of cellular enlargement. Atrophy refers to reduction in size of an organ because of cellular shrinkage. Metaplasia refers to replacement of one differentiated cell type with another. Inflammation results from immune response rather than workload.

2. Apoptosis is a process that results in cellular
   a. atrophy.
   b. death.
   c. proliferation.
   d. mutation.

   ANS: B
   Apoptosis results in death of a cell when it is no longer needed. Atrophy refers to reduction in size of an organ because of cellular shrinkage. Proliferation refers to growth of new cells. Mutation refers to alteration in the genetic structure of cellular DNA.

3. All these cellular responses are potentially reversible *except*
   a. necrosis.
   b. metaplasia.
   c. atrophy.
   d. hyperplasia.

   ANS: A
   Necrosis refers to death of cells/tissue and is not reversible. Metaplasia refers to the replacement of one differentiated cell type with another from persistent injury and is reversible when the injury stops. Atrophy occurs because of lack of use of an organ and is reversible. Hyperplasia is an increase in the number of cells from increased physiologic demands or hormonal stimulation and is reversible.

4. Necrotic death of brain tissue usually produces_____necrosis.
   a. coagulative
   b. caseous
   c. liquefactive
   d. fat

   ANS: C