

## **CHAPTER 3**

### **HOW DRUGS WORK IN THE BODY AND ON THE MIND**

#### **DISCUSSION QUESTIONS AND ASSIGNMENTS**

1. Science-oriented news stories often are featured on a certain day each week in daily blogs, websites, and on a number of medical websites. During the semester, assign students to watch for articles that specifically bear upon one of the neurotransmitters described in the chapter. You might consider having a regularly scheduled “Neurotransmitter of the Week” discussion in class, where information about new findings regarding that neurotransmitter can be shared either as part of a lecture or as a class discussion/presentation.
2. Have students make a list of circumstances under which they feel they would be strongly influenced by the psychological effects of a placebo. Responses can be collected, transcribed (on an anonymous basis to protect their privacy), and photocopied for the entire class to receive as a handout. A class discussion could ensue regarding the reasons why a particular student might think that he or she would have a similar reaction. Likewise, if there is disagreement among students, an interesting discussion could follow regarding individual differences.
3. Bring a square cloth dinner napkin (approximately 18 inches by 18 inches) to class. Wrinkle it up into an oval-shaped ball by folding it into itself like a fan. Try to make it appear as an approximation of the convoluted cerebral cortex. Show it to the class then smooth the napkin out on a flat surface. This is an approximation of the surface area of the cerebral cortex if it were possible to be “un-convoluted.” The class could come up with at least two reasons why it would not have been good for humans to have a larger brain that included a cerebral cortex without convolutions. One reason is that the skull encasing the brain would have been too heavy for us to support at the neck and walk upright at the same time. Another reason is that the larger head would have not been able to fit through the birth canal during labor and delivery. Cortical convolutions have provided a greatly expanded cortical organization for higher-order information processing without requiring a greatly enlarged brain volume.

**NOTE: A useful source for information about prescription and over-the-counter drugs available in the United States can be accessed through the following web site:**

**The National Library of Medicine/National Institutes of Health**  
<http://www.nlm.nih.gov/>

#### **LECTURE OUTLINE FOR CHAPTER THREE**

##### **A. How Drugs Enter the Body**

1. **Oral administration involves ingesting a drug by mouth, digesting it, and absorbing it into the bloodstream through the gastrointestinal tract.** Orally administered drugs have a relatively long absorption time and require specific pharmacological features and circumstances for successful passage into the bloodstream. Enzymes in the liver break down (metabolize) the structure of certain drugs, reducing the amount that eventually enters the bloodstream. This function of the liver is referred to as first-pass metabolism.
2. **Administration by injection allows a drug to be delivered directly into the bloodstream, bypassing the digestive process.** Examples of an injection administration include

intravenous (into a vein), intramuscular (into a muscle), and subcutaneous (underneath the skin) procedures. Of these possibilities, an intravenous injection is the fastest form of drug administration. Heroin injected into the forearm, for example, arrives at the brain in less than fifteen seconds.

3. **Inhalation refers to the ingestion of a drug in a gaseous or vaporous state into the lungs.** It is an extremely rapid form of drug administration. One inhalation method, smoking—burning a substance and breathing the smoke-borne particles in the air—has the disadvantage of carrying toxic particles produced by the burning process into the throat and lungs.
4. **Absorption of drugs can be accomplished by dissolving the drug and allowing it to pass through the skin or thin membranes.** Intranasal and rectal administration involves thin mucous membranes of the nose or rectum, respectively. Transdermal patches permit drugs to be absorbed slowly through the skin. Alternative methods under development include small silicon chips containing a grid of microscopic needles that painlessly pierce the skin and allow the passage of large molecules into the bloodstream.

#### B. How Drugs Exit the Body

1. The body eliminates drugs through a series of biotransformation processes in which the drug is chemically changed into forms called metabolites. A number of factors determine the rate of biotransformation during the elimination process. These factors include the quantity of the drug (alcohol is an exception, its elimination rate being independent of the quantity ingested), the age of the individual, and the drug's fat solubility. A fat-soluble drug will be eliminated more slowly than a water-soluble drug, all other factors being equal.
2. **The elimination half-life is the amount of time required for the drug to be reduced in the bloodstream by 50 percent. Each additional interval of time reduces the quantity of the drug by half until there is a negligible amount remaining.**

#### C. Factors Determining the Behavioral Impact of Drugs

1. One factor that impacts on a drug's behavioral effect is the time interval between two successive administrations of the drug. Time-release forms of medicines allow for a continual absorption over a longer period of time than would a single dose.
2. A second factor is the interacting effect of two different drugs administered at the same time. Drug combinations can be additive, hyperadditive, or antagonistic. **An additive effect produces an end result that is the mathematical sum of the effects of the two drugs separately. A hyperadditive effect produced by a combination of two or more drugs is referred to as synergism. If two drugs are perfectly antagonistic, each one cancels out the effect of the other.**
3. Some drugs can interact with each other during chronic usage. **Cross-tolerance between two drugs is a phenomenon in which the tolerance that results from the chronic use of one drug induces a tolerance effect with regard to a second drug that has not been used before.** Alcohol, barbiturates, and some antianxiety medications, for example, show cross-tolerance. **Cross-dependence is a phenomenon in which one drug can be used to reduce the withdrawal symptoms following the discontinuance of another drug.** Cross-dependence provides the means for continuing an abused drug in the guise of a new one.
4. Features of the individual who is taking the drug can influence the effect of the drug. Such features include weight, gender, ethnic background, and race.

#### D. Introducing the Nervous System

1. **The nervous system is divided into the central nervous system (brain and spinal cord) and the peripheral nervous system.** The peripheral nervous system either brings information in from the environment (sensory pathways) or out to the muscles (motor pathways). Motor control is exerted either through somatic nerves leading to skeletal muscle or autonomic nerves leading to cardiac or smooth muscle.
2. Autonomic nerves are divided into sympathetic and parasympathetic divisions. **Increased activity in sympathetic autonomic nerves produces body changes that are oriented toward dealing with some kind of emergency or stress. Increased activity in parasympathetic autonomic nerves produces body changes that are oriented toward calm, rest, nurturance, and internal maintenance.**

#### E. Understanding the Brain

1. **The brain is divided into the hindbrain, midbrain, and forebrain.** The hindbrain is concerned with basic life-support functions and primitive functions (medulla, pons, reticular formation, and cerebellum). The midbrain is a center for the control of important sensory and motor reflexes, body movements, and the processing of pain information (substantia nigra). The forebrain is concerned with motivational and emotional activity (hypothalamus and limbic system) and complex information-processing (cerebral cortex).
2. Of all the areas within the cerebral cortex, the most recently evolved is a region closest to the front of the brain called prefrontal cortex. Our higher-order, intellectual abilities (often referred to as executive functioning) as well as our personality characteristics emerge from activity in this region. It has been speculated that a dysfunction in the prefrontal cortex may be associated with a loss of personal control with respect to the abuse of alcohol and other drugs.

#### F. Understanding the Neurochemistry of Psychoactive Drugs

1. Psychoactive drugs work by virtue of their effects on the functioning of specialized cells called neurons. **Neurons are cells that receive and transmit information.** The principal components of a neuron are the cell body, the dendrites, and the axon. There are an estimated 100 billion neurons in the brain alone.
2. Communication between neurons is accomplished at the synapse. Synaptic communication can be either excitatory (causing an increase in the activity of the receiving neuron) or inhibitory (causing a decrease in the activity of the receiving neuron).
3. Synaptic communication comprises a sequence of three basic processes. Neurotransmitters stored in the synaptic vesicles are stimulated by a nerve impulse causing (1) neurotransmitter release from the synaptic knob, (2) binding to receptor sites on the surface of another neuron, and (3) reuptake of neurotransmitter into the synaptic knob whence it came.

#### G. The Major Neurotransmitters in Brief: The Big Seven

1. **Synaptic communication is achieved through the action of special molecules called neurotransmitters.** Seven major neurotransmitters in the brain are acetylcholine, norepinephrine, dopamine, 5-hydroxytryptamine (serotonin), gamma aminobutyric acid (GABA), glutamate, and a group of neurotransmitters referred to as endorphins. Whether a neurotransmitter has an excitatory or inhibitory effect depends upon the nature of the receptor at the synapse. Thus, excitation requires the activation of excitatory receptors and inhibition requires the activation of inhibitory receptors.
2. **Psychoactive drugs change the functioning of these and other neurotransmitters at the synapse or alter the functioning of receptors that are sensitive to these molecules.** As

examples, antianxiety drugs stimulate GABA receptors in the brain, cocaine and amphetamines increase dopamine and norepinephrine activity, LSD stimulates serotonin receptors, phencyclidine (PCP) and ketamine block one subgroup of glutamate receptors, and opiates (morphine, heroin, and codeine) stimulate endorphin activity.

#### H. Physiological Aspects of Drug-Taking Behavior

1. **The blood-brain barrier limits the passage of drugs and other molecules from the bloodstream to the brain.** Drugs that are fat-soluble and have relatively small molecular size have a relatively easier passage across the blood-brain barrier.
2. Tolerance effects—the decreased effectiveness of a drug taken in successive administrations—are achieved in two basic ways. **Metabolic tolerance occurs when the biotransformation processes in the liver are lessened over time. Cellular tolerance occurs when neuronal receptors become less sensitive to the drug over time.**
3. The craving response of individuals to certain psychoactive drugs constitutes a major aspect of the process of drug dependence. Two key elements are the neurotransmitter dopamine and a region of the brain called the nucleus accumbens where dopamine is active. Additionally, the insula of the brain has been found to be involved in the craving of drugs due to its involvement in emotion. In a study, twelve out of nineteen smokers with damage to the insula were able to quit smoking easily and were twenty-two times more likely to stop cigarette smoking than those without such damage.

#### I. Psychological Factors in Drug-Taking Behavior

1. **A drug effect can be considered as a three-way interaction between the drug's pharmacological properties, the individual taking the drug (set), and the environment within which drug-taking behavior occurs (setting).** The lower the drug dose, the greater the contribution made by set and/or setting.
2. The specific response to a drug can be influenced by the set of expectations a person may have about what the drug will do. This phenomenon accounts for the effectiveness of inert substances called placebos. Genuine physiological changes can occur due solely to the expectations of the drug user.
3. Due to expectation effects, the study of psychoactive drugs must have certain methodological safeguards. Drugs are tested against a placebo substance that looks and tastes like the drug but lacks the active ingredients of the drug. **In the double-blind research procedure, neither the researcher administering the drug or placebo nor the individual receiving the drug or placebo knows which substance is which.** A double-blind procedure ensures that drug effects are not influenced by either the researcher's expectations or the subject's expectations.

### VIDEO SUGGESTIONS

"Addiction and the human brain" (2006), 25 min. Insight Media, 2162 Broadway, New York NY 10024-0621. Available on DVD.

Presenting studies indicating how drugs affect the developing brain more so than the adult brain and how changes in the brain result from prolonged use of such drugs as cocaine, heroin, nicotine, alcohol, and methamphetamine: there is an exploration of the changes in brain activity that underlie the development of drug dependence.

"Drugs and the brain" (2005), 5-part series, each 51 min. Films for the Humanities and Sciences, 132 West 31<sup>st</sup> Street 17<sup>th</sup> Floor New York, NY 10001. Available on DVD.

Excellent examination of the neurochemistry of drug-taking behavior, illustrated through scientific histories and case studies.

"Constant craving: The science of addiction" (2001), 50 min. Films for the Humanities and Sciences, 132 West 31<sup>st</sup> Street 17<sup>th</sup> Floor New York, NY 10001. Available on DVD.

A look at substance abuse from a biological perspective, including features on new medicinal treatments for addiction and brain research.

"The hijacked brain" (1998), 57 min. Part 2 of the 5-part PBS series, "Close to home: Moyers on addiction," Films for the Humanities and Sciences, 132 West 31<sup>st</sup> Street 17<sup>th</sup> Floor New York, NY 10001. Available on DVD.

This highly acclaimed PBS series spotlights the intimate experience of addiction as shared by the addicts themselves, their parents, children, and those helping them toward recovery. Part 2 examines the powerful new diagnostic tools (including functional MRI) that enable scientists to make discoveries about how addiction affects the brain, including the location of what is termed "the image of desire in the brain."

"Animated neuroscience and the action of nicotine, cocaine, and marijuana in the brain with video clip" (1997), 25 min. Films for the Humanities and Sciences, 132 West 31<sup>st</sup> Street 17<sup>th</sup> Floor New York, NY 10001. Available on DVD.

Using sophisticated 3-D animation, this program takes viewers on a journey deep into the brain to study the effects of the nicotine, cocaine, and marijuana. Viewers learn about the cellular targets of these drugs, as well as how each drug interacts with them and subsequently affects the body. Images of actual neurons used in the animations create a realistic effect that helps viewers understand the concepts presented.

### **ESSAY QUESTIONS FOR CHAPTER 3**

3.1 Describe three of the several ways drugs can be administered to the body, choosing one with a rapid absorption rate, one with a slow absorption rate, and one in between. Discuss the advantages and disadvantages of each of them with respect to toxicity and side effects.

*pp. 61–65*

3.2 Contrast additive and hyperadditive interactions. Give an example of each in terms of a specific drug combination.

*p. 67*

3.3 Contrast the hindbrain, the midbrain, and the forebrain regions in terms of their general responsibilities. Which region do drugs typically affect first, and which region do they typically affect last?

*pp. 72–74*

3.4 Describe the general course of events when one neuron communicates with another at the synapse.

*pp. 74–76*

3.5 Choose one of the seven principal neurotransmitters in the text and describe its role in normal brain functioning and in specific drug effects.

*pp. 76–78*

3.6 If you wanted to facilitate the passage of a drug across the blood-brain barrier, what quality would you want the drug to have? Provide an example of two extreme situations with respect to passage across the blood-brain barrier.

*pp. 78–79*

3.7 How does the double-blind procedure for studies of drug effects allow you to find out whether a drug has a genuine effect on the user beyond a mere placebo effect?

*pp. 83–85*

### TRUE/FALSE QUESTIONS FOR CHAPTER 3

- 3.1 Regardless of which route of administration is used, the goal is for the drug to be absorbed into the bloodstream.  
*p. 61 Ans: T*
- 3.2 An overdose from an orally administered drug is easier to handle on an emergency basis than an overdose of a drug administered through an intravenous injection.  
*pp. 61-62 Ans: T*
- 3.3 High-alkaline drugs (i.e., cocaine, morphine) are absorbed better in the stomach than weakly acidic drugs (i.e., aspirin).  
*pp. 61-62 Ans: F*
- 3.4 Orally administered drugs are ingested at higher than needed doses because some of the drug will not make it through the bloodstream.  
*p. 62 Ans: T*
- 3.5 "First-pass metabolism" is an important function of the esophagus.  
*p. 62 Ans: F*
- 3.6 The intravenous injection is the fastest type of injection to deliver a drug into the bloodstream.  
*p. 62 Ans: T*
- 3.7 Tetanus shots, flu shots, and most inoculations are administered by intramuscular injections.  
*p. 62 Ans: T*
- 3.8 Intramuscular injections are often referred to as skin-popping.  
*p. 63 Ans: F*
- 3.9 The psychoactive effects of intravenous injections are faster than those of inhalation.  
*p. 63 Ans: F*
- 3.10 A major disadvantage of drug inhalation is that the linings leading from the throat to the lungs become irritated over time.  
*p. 63 Ans: T*
- 3.11 Inhalation of smoked drugs such as crack does not present the same hazards to the respiratory system as do tobacco-based cigarettes.  
*p. 63 Ans: F*
- 3.12 Paint thinners, gasoline, and cleaning fluid are examples of abused products that are typically administered by absorption through the skin or membranes.  
*p. 63 Ans: F*
- 3.13 Mild electric currents can be used to help absorb drugs through the skin or membranes.  
*p. 64 Ans: T*
- 3.14 Elimination of drugs can be done via sweat and saliva.  
*p. 64 Ans: T*
- 3.15 The smaller the quantity of the drug, the faster the body tries to get rid of it.  
*p. 64 Ans: F*
- 3.16 Older people eliminate drugs at a slower pace than younger people do.

- 3.17 Fat-soluble drugs are eliminated faster than water-soluble drugs.  
*p. 66 Ans: T*
- 3.18 The elimination half-life of a drug will be faster if the drug is fat-soluble than if it is not.  
*p. 66 Ans: F*
- 3.19 The half-life of cocaine is only a few hours.  
*p. 66 Ans: T*
- 3.20 The half-life of nicotine is a few days.  
*p. 66 Ans: F*
- 3.21 All drugs have similar elimination half-lives.  
*p. 66 Ans: F*
- 3.22 The length of the latency period is related to the absorption time of the drug.  
*p. 66 Ans: T*
- 3.23 Administering the drug in a time-release form helps eliminate the undesirable side effects of excessive concentrations of a drug in the blood.  
*p. 66 Ans: T*
- 3.24 If Drug A has an effect of 3 and Drug B has an effect of 6, a purely additive combination effect would be equivalent to 18.  
*p. 67 Ans: F*
- 3.25 Potentiation involves one drug having no effect at all unless taken with another.  
*p. 67 Ans: T*
- 3.26 Two examples of hyperadditive combinations are synergism and potentiation.  
*p. 67 Ans: T*
- 3.27 The danger of potentiation is that since the drug seems to have no effect, the combined effect may be so powerful that it can become lethal.  
*p. 67 Ans: T*
- 3.28 An example of an antagonistic effect would be if Drug A had an effect of 5 and Drug B had an effect of 3, but the combination of the two drugs together resulted in an effect of 15.  
*p. 67 Ans: F*
- 3.29 Dangerous interactions can occur from food-drug combinations.  
*p. 67 Ans: T*
- 3.30 It is possible to develop a tolerance to a drug you have never taken before.  
*p. 67 Ans: T*
- 3.31 If we can relieve the withdrawal symptoms of one drug by administering another, than the two drugs show cross-tolerance.  
*p. 67 Ans: F*
- 3.32 Cross-dependence can be useful when trying to avoid the withdrawal symptoms of an unavailable drug.  
*p. 68 Ans: T*



- 3.33 A man and a woman each weigh 175 pounds. If they both take the same dose of a drug, the same effects can be expected.  
*p. 69 Ans: F*
- 3.34 Individual differences such as weight and gender can affect how one person reacts to a drug compared to another.  
*p. 69 Ans: T*
- 3.35 According to the text, African Americans smoke fewer cigarettes per day than whites because African Americans may be retaining more nicotine per cigarette than whites.  
*p. 69 Ans: T*
- 3.36 The nervous system is made up of two parts known as the central nervous system and the peripheral nervous system.  
*p. 69 Ans: T*
- 3.37 The central nervous system consists of the brain and the spinal cord.  
*p. 69 Ans: T*
- 3.38 Breathing is to somatic as lifting your arm is to autonomic.  
*p. 70 Ans: F*
- 3.39 The sympathetic and parasympathetic systems together form the peripheral nervous system.  
*p. 70 Ans: F*
- 3.40 An increased heart rate and a decreased rate of digestion are two signs of sympathetic activation.  
*p. 70 Ans: T*
- 3.41 Psychoactive drugs can produce bodily effects that are oriented toward parasympathetic rather than sympathetic activation.  
*p. 71 Ans: T*
- 3.42 Sensory nerves enter the CNS at the level of the brain but not the spinal cord.  
*p. 71 Ans: F*
- 3.43 The processing of reflex responses does not involve the brain at all.  
*p. 71 Ans: T*
- 3.44 Brain tissue is classified in sections: the hindbrain, the midbrain, and the forebrain.  
*p. 72 Ans: T*
- 3.45 The three categories of brain tissue are the medulla, the hypothalamus, and the cerebellum.  
*p. 73 Ans: F*
- 3.46 The risk of asphyxiation from a certain dosage level of a drug most likely means that the drug is capable of stimulating the cerebral cortex.  
*p. 73 Ans: F*
- 3.47 The part of the brain that determines when we sleep and when we wake up is located in the pons.  
*p. 73 Ans: T*
- 3.48 The processing of pain information occurs in the hindbrain.  
*p. 73 Ans: F*
- 3.49 The limbic system and hypothalamus are two structures of the brain that "overhang" the cerebral cortex.

*p. 73 Ans: F*

3.50 Most theories about the physiological basis for psychological dependence focus on the limbic system.

*p. 73 Ans: T*

3.51 The most recently evolved region of the human brain is the prefrontal cortex.

*pp. 73-74 Ans: T*

3.52 Damage to the prefrontal cortex may be associated with loss of personal control with respect to the abuse of alcohol and other drugs.

*p. 74 Ans: T*

3.53 There are approximately 100 billion neurons in the brain.

*p. 74 Ans: T*

3.54 There are certain types of neurons that do not contain a cell body or soma.

*p. 74 Ans: F*

3.55 Dendrites are to transmitting information as axon is to receiving information.

*p. 74 Ans: F*

3.56 Communication between neurons is accomplished through the actions of chemical substances called neurotransmitters.

*p. 75 Ans: T*

3.57 All neurons generate nerve impulses on a continual basis.

*p. 75 Ans: T*

3.58 The receptor to which a neurotransmitter binds determines whether that neurotransmitter has an excitatory or inhibitory effect.

*p. 76 Ans: T*

3.59 Reuptake is the process whereby a neurotransmitter returns from the receptor site back to the synaptic knob.

*p. 76 Ans: T*

3.60 Acetylcholine is involved with the sympathetic autonomic nervous system, while norepinephrine is involved with the parasympathetic autonomic system.

*pp. 76–77 Ans: F*

3.61 Alzheimer's disease has been linked to deficiencies in nicotinic receptors.

*p. 77 Ans: T*

3.62 The neurotransmitter responsible for regulating our mood states is acetylcholine.

*p. 77 Ans: F*

3.63 Norepinephrine is to the hypothalamus as serotonin is to the pons.

*p. 77 Ans: T*

3.64 Drugs that relieve mania and depression act upon serotonin-releasing neurons.

*p. 78 Ans: T*

3.65 GABA deficiencies are associated with a decreased tendency toward epileptic seizures.

*p. 78 Ans: F*

- 3.66 Antianxiety medications stimulate GABA-releasing neurons, providing a reduction in feelings of stress and fear.  
*p. 78 Ans: T*
- 3.67 The blood-brain barrier cannot be crossed by a drug that is fat soluble.  
*p. 78 Ans: F*
- 3.68 The key factor which determines whether a drug passes through the blood-brain barrier is water solubility.  
*p. 79 Ans: F*
- 3.69 Barbiturates and caffeine easily pass through the blood-brain barrier.  
*p. 79 Ans: T*
- 3.70 Dopamine is more fat-soluble than L-dopa.  
*p. 80 Ans: F*
- 3.71 A major drug for the treatment of Parkinson's disease has been L-dopa.  
*p. 80 Ans: T*
- 3.72 Tolerance that is a result of changes in the drug's chemical breakdown in the liver is referred to as cellular (pharmacodynamic) tolerance.  
*p. 80 Ans: F*
- 3.73 Metabolic tolerance occurs when receptors become less sensitive due to being stimulated repeatedly by a drug over time.  
*p. 80 Ans: F*
- 3.74 When multiple drugs activate the same type of receptor sites, the effects of each drug on the brain are equivalent.  
*p. 80 Ans: T*
- 3.75 The rewarding effects of certain psychoactive drugs are related to their effects upon the nucleus accumbens in the brain.  
*p. 81 Ans: T*
- 3.76 Involvement with the nucleus accumbens has been linked to compulsive gambling  
*p. 81 Ans: T*
- 3.77 Involvement with the nucleus accumbens has been linked to compulsive violence.  
*p. 81 Ans: F*
- 3.78 Set is defined as the immediate environment within which drug-taking behavior occurs.  
*p. 83 Ans: F*
- 3.79 Set and setting are two important factors in predicting an individual's response to a particular drug.  
*p. 82 Ans: T*
- 3.80 Placebo is derived from the Latin, "I refuse to comply."  
*p. 83 Ans: F*
- 3.81 A placebo effect involves totally imaginary symptoms and reactions.  
*p. 83 Ans: F*
- 3.82 A placebo contains ingredients that are completely inert.  
*p. 83 Ans: T*

3.83 In a double-blind procedure, neither the individual administering the drug or placebo nor the individual receiving the drug or placebo knows which substance is which.

*p. 85 Ans. T*

**MULTIPLE-CHOICE QUESTIONS FOR CHAPTER 3**  
**(1 - easy, 2 - medium, 3 - difficult)**

3.1 According to the text, which of the following is NOT a principal route of drug administration?

- A. absorption through skin membranes
- B. injection
- C. inhalation
- D. biotransformation

**1 p. 61 Ans: D**

3.2 Psychoactive drugs affect our behavior and experience \_\_\_\_\_.

- A. by altering the functioning of the brain
- B. by purely psychological means
- C. by adjusting our expectations toward a given response
- D. only if they are ingested orally

**1 p. 61 Ans: A**

3.3 Which route of drug administration is the oldest and easiest?

- A. oral
- B. inhalation
- C. injection
- D. absorption through skin or membranes

**2 p. 61 Ans: A**

3.4 An oral administration refers to a delivery through the \_\_\_\_\_.

- A. larynx
- B. lungs
- C. skin
- D. mouth

**1 p. 61 Ans: D**

3.5 Protection against toxic drugs is maximized when delivered through which route of administration?

- A. inhalation
- B. injection
- C. oral
- D. absorption through skin or membranes

**2 p. 62 Ans: C**

3.6 Which route of administration provides the slowest absorption into the brain, in general?

- A. oral
- B. absorption through skin or membranes
- C. inhalation
- D. injection

**2 p. 62 Ans: A**

3.7 Digestion is a requirement for the absorption of drugs through which route of administration?

- A. anal
- B. oral
- C. intranasal
- D. inhalation

**2 p. 62 Ans: B**

3.8 Alcohol and caffeine are drugs that share a common \_\_\_\_\_ route of administration.

- A. skin-absorption
- B. vaporous inhalation

- C. oral
- D. sublingual

**1 p. 62 Ans: C**

3.9 When taken orally, weakly acidic drugs are absorbed \_\_\_\_\_ strongly acidic drugs.

- A. to a lesser degree than
- B. better than
- C. in an equivalent manner to
- D. slower and less completely than

**3 p. 62 Ans: B**

3.10 The term that describes a substance that is soluble in fat is \_\_\_\_\_.

- A. insipid-soluble
- B. lipid-soluble
- C. capillary-soluble
- D. monolipid-soluble

**2 p. 62 Ans: B**

3.11 Constant changes in the state of the gastrointestinal tract can make it difficult to predict the strength of the drug once it reaches the bloodstream. This problem would be associated with which route of administration?

- A. intranasal
- B. sublingual
- C. oral
- D. subcutaneous

**2 p. 62 Ans: C**

3.12 Which of the following forms of drug administration is the fastest?

- A. intravenous
- B. intramuscular
- C. oral
- D. sublingual

**3 p. 62 Ans: A**

3.13 Which of the following delivers a drug into the bloodstream in the quickest manner?

- A. intramuscular injection
- B. intravenous injection
- C. subcutaneous injection
- D. intranasal absorption

**2 p. 62 Ans: B**

3.14 The effects of abused drugs delivered by injection are known as \_\_\_\_\_.

- A. streamlining
- B. mainlining
- C. veinlining
- D. intravenous-lining

**1 p. 62 Ans: B**

3.15 With intramuscular injections, the drug is absorbed into the bloodstream through the \_\_\_\_\_ serving the muscle.

- A. arteries
- B. veins
- C. capillaries
- D. muscle membranes

**2 p. 62 Ans: C**

- 3.16 Inoculations are typically administered via \_\_\_\_\_ injections.
- A. intravenous
  - B. intracellular
  - C. intramuscular
  - D. subcutaneous

1 p. 62 Ans: C

- 3.17 Which of the following is NOT an injection technique?
- A. intravenous
  - B. intramuscular
  - C. subcutaneous
  - D. vein-popping

2 p. 62 Ans: D

- 3.18 The order of absorption times from slowest to fastest in the following injections are \_\_\_\_\_.
- A. subcutaneous, intravenous, intramuscular
  - B. intramuscular, subcutaneous, intravenous
  - C. intramuscular, intravenous, subcutaneous
  - D. subcutaneous, intramuscular, intravenous

3 p. 62 Ans: D

- 3.19 Analogy: Mainlining is to skin-popping as \_\_\_\_\_.
- A. subcutaneous is to intravenous
  - B. intravenous is to intramuscular
  - C. intravenous is to subcutaneous
  - D. intramuscular is to subcutaneous

3 pp. 62–63 Ans: C

- 3.20 Which of the following disadvantages applies to subcutaneous injections?
- A. Only a small amount of drug can be injected.
  - B. It is difficult to achieve a precise control over the dosage.
  - C. The absorption time is faster than that of intravenous injections.
  - D. It is impossible to achieve a steady absorption of the drug into the bloodstream.

3 p. 63 Ans: A

- 3.21 A problem inherent in all forms of injection involves \_\_\_\_\_.
- A. the relatively slow rate of absorption
  - B. the need for the individual to be conscious
  - C. the possible collapse of a vein
  - D. the risk of infection if the needle is not sterile

2 p. 63 Ans: D

- 3.22 A chemical substance can travel from lungs to the brain in \_\_\_\_\_.
- A. five to eight seconds
  - B. about a minute and a half
  - C. about the same time as when injected sub-Q
  - D. one-half second or less

3 p. 63 Ans: A

- 3.23 Smoking is a method of inhalation that depends upon \_\_\_\_\_.
- A. vapors traveling freely in the air
  - B. specialized medical equipment
  - C. smoke-borne particles in the air
  - D. liquids that have combined with air molecules

2 p. 63 Ans: C

- 3.24 Drugs administered through smoking include \_\_\_\_\_.  
A. opium  
B. nicotine from cigarettes  
C. crystallized forms of methamphetamine  
D. all of the above

1 p. 63 Ans: D

- 3.25 Risks of emphysema, asthma, and cancer are associated with \_\_\_\_\_.  
A. tars and hydrocarbons in inhaled smoke  
B. non-sterile injection needles  
C. long-term irritation from subcutaneous injections  
D. allergic reactions to hypodermic syringes

1 p. 63 Ans: A

- 3.26 Paint thinners, gasoline, and cleaning fluid are typically associated with which route of administration?  
A. smoking  
B. vaporous inhalation  
C. absorption through the skin  
D. oral

2 p. 63 Ans: B

- 3.27 Sniffing employs the same route of administration as \_\_\_\_\_.  
A. snorting  
B. smoking  
C. subcutaneous injections  
D. inhalation methods

2 p. 63 Ans: A

- 3.28 Inhalation is to gas as snorting is to \_\_\_\_\_.  
A. liquid  
B. smoke  
C. powder  
D. vapor

2 p. 63 Ans: C

- 3.29 Intramuscular is to capillaries as intranasal is to \_\_\_\_\_.  
A. mucus membranes  
B. snorting  
C. veins  
D. lungs

2 p. 63 Ans: A

- 3.30 In a sublingual administration, the drug is placed \_\_\_\_\_.  
A. over the dorsal surface of the arm  
B. under the tongue  
C. into the nose  
D. directly into the lingual vein

2 p. 64 Ans: B

- 3.31 Suppositories are typically administered \_\_\_\_\_.  
A. sublingually  
B. subcutaneously  
C. rectally  
D. transdermally

1 p. 64 Ans: C



3.32 Suppositories may be necessary if \_\_\_\_\_.

- A. the individual is vomiting
- B. the individual is unconscious
- C. oral administration is impossible
- D. all of the above

2 p. 64 Ans: D

3.33 A transdermal patch works through the principle of \_\_\_\_\_.

- A. inhalation
- B. oral absorption
- C. absorption through the skin
- D. slow absorption through a muscle

1 p. 64 Ans: C

3.34 Analogy: Sublingual is to transdermal as \_\_\_\_\_.

- A. tongue is to skin
- B. vein is to muscle
- C. powder is to smoke
- D. nose is to tongue

3 p. 64 Ans: A

3.35 A technique well-suited for long-term, gradual administration of a drug is a(n) \_\_\_\_\_.

- A. intramuscular clamp
- B. transdermal patch
- C. intranasal loop
- D. lung implantation

2 p. 64 Ans: B

3.36 Silicon chip patches that contain a grid of microscopic needles are used to deliver drugs \_\_\_\_\_.

- A. orally
- B. intravenously
- C. through the skin
- D. through the tongue

2 p. 64 Ans: C

3.37 The most common means of drug elimination is through excretion in the \_\_\_\_\_.

- A. feces
- B. urine
- C. saliva
- D. exhaled breath

1 p. 64 Ans: B

3.38 Which of the following is NOT a way in which the body eliminates drugs?

- A. saliva
- B. feces and urine
- C. sweat
- D. inhaled breath

1 p. 64 Ans: D

3.39 Biotransformation is a process accomplished in the \_\_\_\_\_.

- A. mouth
- B. liver
- C. stomach
- D. esophagus

**1 p. 64 Ans: B**

3.40 Products of biotransformation are called \_\_\_\_\_.

- A. metabolites
- B. enzymatic residues
- C. biotransformables
- D. urinary particles

**2 p. 64 Ans: A**

3.41 The processes of biotransformation and urinary excretion are influenced by \_\_\_\_\_.

- A. the concentration of the drug in the bloodstream
- B. the presence of other drugs in the bloodstream
- C. the chemical properties of the drug
- D. all of the above

**3 p. 64 Ans: D**

3.42 The \_\_\_\_\_ the quantity of the drug, the \_\_\_\_\_ the body tries to get rid of it.

- A. larger; slower
- B. smaller; faster
- C. larger; faster
- D. there is no relationship between the quantity of the drug and the speed with which the body tries to excrete it.

**2 p. 64 Ans: C**

3.43 As a person gets older, the enzyme activity in the liver \_\_\_\_\_.

- A. increases
- B. decreases
- C. stays the same
- D. completely stops

**2 p. 66 Ans: B**

3.44 The rate of elimination of a particular drug can be determined by an index called \_\_\_\_\_.

- A. the elimination quarter-life
- B. the elimination half-life
- C. the elimination rate-life
- D. the elimination declination life

**1 p. 66 Ans: B**

3.45 The elimination half-life index of a drug is determined by \_\_\_\_\_.

- A. dividing in half the total time the drug produces an effect
- B. dividing in half the user's age
- C. noting the time it takes for the concentration to decline by half
- D. a combination of the above

**3 p. 66 Ans: C**

3.46 Of the following drugs, which has the longest elimination half-life?

- A. cocaine
- B. marijuana
- C. nicotine
- D. caffeine

**3 p. 66 Ans: B**

3.47 Which of the following plays the most important role in determining the final result after a drug is repeatedly administered?

- A. the timing of drug administration
- B. the acute effects of drugs administered close together in time

- C. the chronic effects of drugs administered close together in time
- D. the age of the individual

2 p. 66 Ans: A

3.48 A latency period occurs \_\_\_\_\_.

- A. late in a drug administration, when concentrations declined
- B. in the "middle" of the interval, when drug effect has been observed
- C. when it is realized that the drug was really a placebo
- D. when drug concentrations are increasing in the blood but no drug effect has yet been detected

3 p. 66 Ans: D

3.49 If a drug is taken at noon and an effect is detected at 12:05 but no longer detected by 1:00, it is reasonable to assume that the latency period occurred at \_\_\_\_\_.

- A. 12:04
- B. 12:07
- C. 12:55
- D. 1:15

3 p. 66 Ans: A

3.50 It is possible for drug concentrations to continue to rise in the blood \_\_\_\_\_.

- A. even when there is no longer any effect at all
- B. even when the effect has reached maximum strength
- C. even when the effect has begun to decline
- D. even when the individual has not taken the drug

2 p. 66 Ans: B

3.51 The technique used to keep the concentration of the drug high enough to be effective yet low enough to avoid toxic effects is known as the \_\_\_\_\_.

- A. time-sensitive form
- B. time-release form
- C. time-suspension form
- D. time-mark form

2 p. 66 Ans: B

3.52 A solution to the problem of undesirable side effects due to excessive concentrations of the drug in the blood is \_\_\_\_\_.

- A. a placebo
- B. taking twice the recommended dosage
- C. a time-release form of the drug
- D. avoiding the therapeutic window

2 p. 66 Ans: C

3.53 You have a better chance of staying within the therapeutic window with \_\_\_\_\_.

- A. a tamper-proof drug container
- B. a time-release form of the drug
- C. an easily digested form of the drug
- D. an injection of the drug

1 p. 66 Ans: B

3.54 When the combination of two drugs results in an acute effect that is equivalent to the sum of the effects of either drug administered separately, the effect is known as \_\_\_\_\_.

- A. subtractive
- B. multiplicative
- C. additive
- D. obtuse

1 p. 67 Ans: C

3.55 If Drug A has an effect of 5 and Drug B has an effect of 8, a purely additive combination effect would be equivalent to \_\_\_\_\_.

- A. 0
- B. 10
- C. 13
- D. 22

1 p. 67 Ans: C

3.56 If one drug has an effect of 6, a second drug has an effect of 8, and the combination of the 2 drugs has an effect of 20, then the interaction is \_\_\_\_\_.

- A. synergistic
- B. additive
- C. antagonistic
- D. all of the above

2 p. 67 Ans: A

3.57 Synergism and potentiation are special cases of \_\_\_\_\_.

- A. an additive combination
- B. a hypoaddivitive combination
- C. a hyperadditive combination
- D. a postadditive combination

2 p. 67 Ans: C

3.58 If there is a very strong effect when two drugs are taken in combination, even though one of the drugs by itself has no effect and the other by itself has only a weak effect, then the combination effect is called \_\_\_\_\_.

- A. additive
- B. subtractive
- C. synergistic
- D. potentiation

2 p. 67 Ans: D

3.59 If one drug has an effect of 6 and a second drug has an effect of 6, but the combination of the two drugs has an effect of 0, then the interaction is \_\_\_\_\_.

- A. synergistic
- B. antagonistic
- C. hyperadditive
- D. additive

2 p. 67 Ans: B

3.60 Developing a tolerance for a drug's effect results in tolerance for the effects of another drug never taken; this is known as \_\_\_\_\_.

- A. cross-reference
- B. cross-tolerance
- C. cross-dependence
- D. cross-induction

1 p. 67 Ans: B

3.61 Cross-tolerance is commonly observed in the effects of \_\_\_\_\_.

- A. cocaine
- B. nicotine
- C. benzodiazepines
- D. marijuana

3 p. 67 Ans: C

3.62 Which of the following is NOT an example of cross-tolerance?

- A. a barbiturate abuser having to drink more than usual before getting drunk
- B. an alcoholic needing a greater amount of anesthetic when undergoing surgery
- C. liquid heroin abuser needing increasingly higher doses when snorting it
- D. All of the above are examples.

3 p. 67 Ans: C

3.63 Dangerous interactions can result from \_\_\_\_\_.

- A. drug/drug combinations
- B. food/drug combinations
- C. both A and B
- D. neither A nor B

2 p. 68 Ans: C

3.64 The combination of morphine or heroin with naloxone or naltrexone is an example of \_\_\_\_\_.

- A. potentiation
- B. synergism
- C. an additive effect
- D. an antagonistic effect

3 p. 68 Ans: D

3.65 When one drug can substitute for the physiological effects produced by a second drug that has been discontinued, this phenomenon is known as \_\_\_\_\_.

- A. cross-reference
- B. cross-dependence
- C. cross-tolerance
- D. cross-induction

1 p. 67 Ans: B

3.66 A man using barbiturates to hide an addiction is an example of \_\_\_\_\_.

- A. cross-reference
- B. cross-tolerance
- C. cross-dependence
- D. cross-induction

2 p. 67 Ans: C

3.67 Which of the following can affect how one person reacts to a drug compared to another?

- A. weight
- B. ethnicity
- C. gender
- D. all of the above

2 p. 69 Ans: D

3.68 Women may be affected more by alcohol than men due to \_\_\_\_\_.

- A. having a lower proportion of water than men
- B. reduced levels of enzymes that break down alcohol in the liver
- C. having a lower fat-to-muscle ratio than men
- D. both A and B

3 p. 69 Ans: D

3.69 A lower proportion of water in a woman relative to an equivalently weighted man \_\_\_\_\_.

- A. is related to a lower fat-to-muscle ratio in women
- B. will make women more affected by alcohol
- C. has been found to have no effect on how a person is affected by alcohol
- D. is related to an increased level of enzymes that metabolize alcohol in the liver

3 p. 69 Ans: B

- 3.70 About half of all individuals of Asian descent have \_\_\_\_\_.
- A. low levels of an enzyme involved in the metabolism of alcohol
  - B. low levels of an enzyme involved in the metabolism of caffeine
  - C. high levels of an enzyme involved in the metabolism of most drugs
  - D. high levels of an enzyme involved in the metabolism of antibacterial drugs

2 p. 69 Ans: A

- 3.71 Asian schizophrenic patients \_\_\_\_\_ Caucasian patients when taking antipsychotic medication.
- A. are less sensitive than
  - B. are more sensitive than
  - C. are equivalent relative to
  - D. show a faster metabolism than

3 p. 69 Ans: B

- 3.72 According to the text, \_\_\_\_\_ smoke fewer cigarettes per day than \_\_\_\_\_.
- A. African Americans, whites
  - B. whites, African Americans
  - C. Hispanics, Asians
  - D. Asians, African Americans

2 p. 69 Ans: A

- 3.73 Which of the following is true?
- A. African Americans retain more nicotine per cigarette than white smokers, smoking, therefore, fewer cigarettes per day.
  - B. African Americans retain less nicotine per cigarette than white smokers, smoking, therefore, fewer cigarettes per day.
  - C. whites retain more nicotine per cigarette than African Americans, smoking, therefore, fewer cigarettes per day.
  - D. Asians retain more nicotine per cigarette than white smokers, smoking, therefore, more cigarettes per day.

3 p. 69 Ans: A

- 3.74 African Americans have a(n) \_\_\_\_\_.
- A. relatively fast rate of nicotine metabolism
  - B. relatively slow rate of nicotine metabolism
  - C. rate of nicotine metabolism equal to whites
  - D. immunity to drug dependence

2 p. 69 Ans: B

- 3.75 The central nervous system consists of the \_\_\_\_\_.
- A. somatic and autonomic systems
  - B. brain and spinal cord
  - C. brain and autonomic system
  - D. sympathetic and parasympathetic systems

1 p. 70 Ans: B

- 3.76 Sensory pathways leading to the CNS are considered part of the \_\_\_\_\_.
- A. autonomic system
  - B. extracranial system
  - C. peripheral nervous system
  - D. sympathetic branch of the autonomic nervous system

2 p. 70 Ans: C

- 3.77 Kicking your legs is considered a \_\_\_\_\_ response.

- A. skeletal
- B. somatic
- C. autonomic
- D. gastrointestinal

1 p. 70 Ans: B

3.78 Analogy: \_\_\_\_\_ is to voluntary as \_\_\_\_\_ is to involuntary.

- A. somatic; psychosomatic
- B. somatic; autonomic
- C. psychosomatic; somatic
- D. autonomic; somatic

2 p. 70 Ans: B

3.79 \_\_\_\_\_ is to skeletal muscle as \_\_\_\_\_ is to smooth muscle.

- A. Somatic; psychosomatic
- B. Somatic; autonomic
- C. Psychosomatic; somatic
- D. Autonomic; somatic

2 p. 70 Ans: B

3.80 An autonomic response involves which kind of muscle?

- A. skeletal
- B. somatic
- C. smooth
- D. rigid

2 p. 70 Ans: C

3.81 An acceleration or deceleration of the heart rate is considered a \_\_\_\_\_ response.

- A. somatic
- B. skeletal
- C. autonomic
- D. gastrointestinal

2 p. 70 Ans: C

3.82 Bodily changes that result from stressful or emergency situations are handled by the \_\_\_\_\_.

- A. peripheral nervous system in general
- B. parasympathetic branch of the autonomic nervous system
- C. skeletal muscles attached to bone
- D. sympathetic branch of the autonomic nervous system

1 p. 70 Ans: D

3.83 The sympathetic and parasympathetic systems are two branches of the \_\_\_\_\_.

- A. peripheral nervous system
- B. central nervous system
- C. autonomic nervous system
- D. spinal cord

1 p. 70 Ans: C

3.84 Sympathetic activation can result in all of the following EXCEPT \_\_\_\_\_.

- A. increased blood pressure
- B. dilation of the bronchi in the lungs
- C. dilation of the pupils in the eyes
- D. increased function of the gastrointestinal tract

3 p. 70 Ans: D

3.85 Which response would be a result of sympathetic activation?

- A. a higher level of blood pressure
- B. a slower heart rate
- C. an increased rate of digestion
- D. a constriction in the pupil of the eye

2 p. 70 Ans: A

3.86 Parasympathetic activation can result in all of the following EXCEPT \_\_\_\_\_.

- A. decreased heart rate
- B. decreased blood pressure
- C. constriction of pupils and bronchi
- D. decreased function of the gastrointestinal tract

1 p. 71 Ans: D

3.87 A lower level of blood pressure is typically associated with \_\_\_\_\_.

- A. a faster heart rate
- B. an increased rate of digestion
- C. a dilation of the pupil of the eye
- D. a dilation of the bronchi in the lungs

2 p. 71 Ans: B

3.88 According to the text, the most important part of the CNS is \_\_\_\_\_.

- A. the brain
- B. the spinal cord
- C. parasympathetic activation
- D. neural pathways

2 p. 71 Ans: A

3.89 Neurons are specialized cells that \_\_\_\_\_.

- A. dilate and constrict
- B. receive and transmit information
- C. reject foreign particles in the body
- D. form the walls of the heart

1 p. 72 Ans: B

3.90 If you were to order the three classifications of brain tissue from the most primitive to the most recently evolved part of the human brain, it would in which order?

- A. forebrain, midbrain, hindbrain
- B. hindbrain, forebrain, midbrain
- C. midbrain, hindbrain, forebrain
- D. hindbrain, midbrain, forebrain

3 p. 72 Ans: D

3.91 The most recently evolved part of the human brain is the \_\_\_\_\_.

- A. hindbrain
- B. forebrain
- C. midbrain
- D. spinal cord

3 p. 73 Ans: B

3.92 The coordinator of the basic life-support systems of the body is the \_\_\_\_\_.

- A. medulla
- B. pons
- C. cerebellum
- D. limbic system

2 p. 73 Ans: A



3.93 Opiates, alcohol, barbiturates, and other depressants are potentially dangerous since there is the risk of inhibiting \_\_\_\_\_.

- A. blood pressure
- B. digestion
- C. the vomiting reflex
- D. respiration

3 p. 73 Ans: D

3.94 Which of the following is part of the hindbrain?

- A. somatic system
- B. medulla
- C. autonomic nervous system
- D. cortex

1 p. 73 Ans: B

3.95 Which of the following is NOT part of the hindbrain?

- A. medulla
- B. pons
- C. cerebellum
- D. limbic system

2 p. 73 Ans: D

3.96 Asphyxiation can occur when respiratory centers in the \_\_\_\_\_ are inhibited.

- A. cerebellum
- B. lungs
- C. medulla
- D. forebrain

2 p. 73 Ans: C

3.97 The vomiting center of the brain is located in the \_\_\_\_\_.

- A. medulla
- B. pons
- C. cerebellum
- D. substantia nigra

2 p. 73 Ans: A

3.98 Alcohol's depressive effect occurs in which area of the hindbrain?

- A. medulla
- B. pons
- C. reticular formation
- D. cerebellum

2 p. 73 Ans: D

3.99 The reticular formation is located in the \_\_\_\_\_.

- A. medulla
- B. pons
- C. cerebellum
- D. limbic system

2 p. 73 Ans: B

3.100 Maintaining the necessary level of alertness when we are conscious and awake is the responsibility of the \_\_\_\_\_.

- A. cerebellum
- B. reticular formation
- C. hypothalamus and limbic system
- D. medial forebrain bundle

2 p. 73 Ans: B

- 3.101 Inhibition of the \_\_\_\_\_ is the reason for dizziness after drinking alcohol.
- A. substantia nigra
  - B. cerebral cortex
  - C. cerebellum
  - D. central nervous system in general

2 p. 73 Ans: C

- 3.102 Hindbrain is to cerebellum as midbrain is to \_\_\_\_\_.
- A. pons
  - B. cerebral cortex
  - C. substantia nigra
  - D. hypothalamus

3 p. 73 Ans: C

- 3.103 Body movement depends on which part of the brain?
- A. cerebral cortex
  - B. hypothalamus
  - C. substantia nigra
  - D. both A and C

2 p. 73 Ans: C

- 3.104 Degeneration of the substantia nigra results in \_\_\_\_\_.
- A. Parkinson's disease
  - B. a strange effect of prolonged euphoria
  - C. a reduction in the effects of antipsychotic medication
  - D. cortical inhibition

3 p. 73 Ans: A

- 3.105 Motivational and emotional behaviors are controlled by the \_\_\_\_\_.
- A. hindbrain
  - B. hypothalamus
  - C. limbic system
  - D. both B and C

2 p. 73 Ans: D

- 3.106 The hypothalamus controls \_\_\_\_\_.
- A. feeding behavior
  - B. drinking behavior
  - C. sexual behavior
  - D. all of the above

2 p. 73 Ans: D

- 3.107 More than 80 percent of the cerebral cortex is referred to as \_\_\_\_\_.
- A. sensory cortex
  - B. sensory and motor cortex
  - C. association cortex
  - D. motor cortex

2 p. 73 Ans: C

- 3.108 The most recently evolved region of the human brain is the \_\_\_\_\_.
- A. limbic system
  - B. prefrontal cortex
  - C. parasympathetic nervous system
  - D. cerebellum

**2 p. 73 Ans: B**

- 3.109 Midbrain is to sensory and motor reflexes as forebrain is to \_\_\_\_\_.  
A. emotional and motivational acts  
B. basic life functions  
C. instinctive behaviors  
D. sleeping patterns

**3 p. 73 Ans: A**

- 3.110 The long appendage extending from the cell body of a neuron is referred to as the \_\_\_\_\_.  
A. dendrite  
B. axon  
C. synaptic knob  
D. synaptic cleft

**1 p. 74 Ans: B**

- 3.111 The "on" state of the neuron is generally referred to as the \_\_\_\_\_.  
A. dendritic charge  
B. nerve impulse  
C. synaptic knob-knocker  
D. axonic metabolite

**1 p. 74 Ans: B**

- 3.112 The bulk of the neuron is attributed to the \_\_\_\_\_.  
A. nerve impulse  
B. cell body  
C. axons  
D. dendrites

**2 p. 74 Ans: B**

- 3.113 The gap between neurons is known as the \_\_\_\_\_.  
A. neurological gap  
B. synapse  
C. neurotransmitters  
D. synaptic knobs

**2 p. 75 Ans: B**

- 3.114 Approximately how long does a neurotransmitter molecule remain in the receptor site?  
A. two minutes  
B. one second  
C. one-quarter of a second  
D. one millisecond

**3 p. 76 Ans: D**

- 3.115 Reuptake refers to the "returning back" of the neurotransmitter to the \_\_\_\_\_.  
A. vesicles in the synaptic knob  
B. receptor sites  
C. heart and other internal organs  
D. cerebral cortex

**1 p. 76 Ans: A**

- 3.116 How many neurotransmitters are there?  
A. two  
B. one  
C. more than fifty  
D. two, three, or four (the exact number is in doubt)

1 p. 76 Ans: C

3.117 Muscarinic receptors and nicotinic receptors are receptor sites that are sensitive to which neurotransmitter?

- A. norepinephrine
- B. acetylcholine
- C. dopamine
- D. gamma aminobutyric acid

3 p. 76 Ans: B

3.118 Acetylcholine-sensitive receptors in the parasympathetic autonomic nervous system are called \_\_\_\_\_.

- A. nicotinic receptors
- B. muscarinic receptors
- C. motor receptors
- D. curare receptors

3 p. 76 Ans: B

3.119 Atropine is a drug that \_\_\_\_\_.

- A. reduces schizophrenic symptoms
- B. reduces feelings of anxiety
- C. inhibits feelings of anger and frustration
- D. inhibits acetylcholine at muscarinic receptors

3 p. 77 Ans: D

3.120 The poison curare is considered a(n) \_\_\_\_\_.

- A. antimuscarinic drug
- B. antinicotinic drug
- C. antagonistic drug to opiates
- D. drug related to dopamine

3 p. 77 Ans: B

3.121 According to the text, deficiencies in acetylcholine and/or nicotine receptors are linked to \_\_\_\_\_.

- A. nicotine addiction
- B. Parkinson's disease
- C. Alzheimer's disease
- D. emphysema

2 p. 77 Ans: C

3.122 The major neurotransmitter for sympathetic autonomic activation is \_\_\_\_\_.

- A. acetylcholine
- B. dopamine
- C. serotonin
- D. norepinephrine

2 p. 77 Ans: D

3.123 Through norepinephrine is found all over the brain, in which part is it most concentrated?

- A. medulla
- B. limbic system
- C. hypothalamus
- D. both B and C

3 p. 77 Ans: D

3.124 What aspects of human behavior are affected by the neurotransmitter dopamine?

- A. motor control

- B. emotionality
- C. drug cravings
- D. all of the above

**3 p. 77 Ans: D**

3.125 A deficiency in motor control can result from a degeneration of neurons sensitive to which major neurotransmitter?

- A. acetylcholine
- B. dopamine
- C. serotonin
- D. norepinephrine

**3 p. 77 Ans: B**

3.126 Analogy: \_\_\_\_\_ is to Alzheimer's disease as \_\_\_\_\_ is to Parkinson's disease.

- A. Norepinephrine; dopamine
- B. Serotonin; dopamine
- C. Acetylcholine; dopamine
- D. Serotonin; acetylcholine

**1 p. 77 Ans: C**

3.127 \_\_\_\_\_ is a disorder resulting from degeneration of dopamine releasing neurons in the substantia nigra of the midbrain.

- A. Nicotine addiction
- B. Parkinson's disease
- C. Alzheimer's Disease
- D. Emphysema

**2 p. 77 Ans: B**

3.128 Which of the following disorders has NOT been linked to dopamine?

- A. Parkinson's disease
- B. Alzheimer's disease
- C. schizophrenia
- D. both B and C

**3 p. 77 Ans: B**

3.129 Schizophrenia is strongly suspected to be related to neurons sensitive to \_\_\_\_\_.

- A. acetylcholine
- B. serotonin
- C. dopamine
- D. norepinephrine

**2 p. 77 Ans: C**

3.130 Serotonin is most concentrated in which part of the brain?

- A. medulla and pons
- B. limbic system
- C. cortex
- D. all of the above

**2 p. 78 Ans: D**

3.131 Serotonin plays an important role in regulating \_\_\_\_\_.

- A. patterns of sleep
- B. feelings of stress and fear
- C. one's reaction to pain
- D. our movements

**2 p. 78 Ans: A**

3.132 The technical name for \_\_\_\_\_ is 5-hydroxytryptamine (abbreviated 5-HT).

- A. serotonin
- B. dopamine
- C. acetylcholine
- D. norepinephrine

3 p. 78 Ans: A

3.133 Which two major neurotransmitters are considered responsible for establishing appropriate levels of mood?

- A. serotonin and acetylcholine
- B. dopamine and endorphins
- C. acetylcholine and norepinephrine
- D. serotonin and norepinephrine

3 p. 78 Ans: D

3.134 It is reasonable that antiepileptic medications would increase levels of \_\_\_\_\_.

- A. dopamine
- B. GABA
- C. endorphins
- D. serotonin

3 p. 78 Ans: B

3.135 Which of the following statements about glutamate is NOT true?

- A. Glutamate functions as an excitatory neurotransmitter in the brain.
- B. Glutamate receptors are blocked by some psychoactive drugs.
- C. Glutamate receptors are activated by the presence of some psychoactive drugs.
- D. Drugs that block glutamate receptors have been largely unsuccessful in treating drug abuse.

3 p. 78 Ans: D

3.136 Pain-killing drugs bear a remarkable resemblance to \_\_\_\_\_.

- A. endorphins
- B. dopamine
- C. acetylcholine
- D. serotonin

1 p. 78 Ans: A

3.137 A group of neurotransmitters which serve as natural painkillers are called \_\_\_\_\_.

- A. endorphins
- B. gamma aminobutyric acids
- C. serotonin
- D. norepinephrine

2 p. 78 Ans: A

3.138 A major function of endorphins is to \_\_\_\_\_.

- A. allow us to fall asleep
- B. cause us to feel less pain
- C. prevent schizophrenia
- D. reduce hallucinations after LSD is ingested

1 p. 78 Ans: B

3.139 Athletes can experience a "runner's high," or euphoria, during strenuous physical activity due to elevated levels of \_\_\_\_\_.

- A. GABA
- B. endorphins
- C. acetylcholine
- D. norepinephrine

2 p. 79 Ans: B

- 3.140 The analgesic effects of Chinese acupuncture can be reversed by \_\_\_\_\_.
- A. dopamine
  - B. serotonin
  - C. acetylcholine
  - D. naloxone

3 p. 79 Ans: D

- 3.141 What is the blood-brain barrier responsible for?
- A. guarding the brain by keeping blood from “drowning” brain cells
  - B. acting as a resource for neurotransmitters in the blood to communicate with the brain
  - C. prohibiting drugs and other molecules from passing from the bloodstream into the brain
  - D. all of the above

2 p. 79 Ans: C

- 3.142 The key factor in determining passage across the blood-brain barrier is \_\_\_\_\_.
- A. protein linkages
  - B. fat solubility
  - C. stability in the brain
  - D. spinal cord compatibility

2 p. 78 Ans: B

- 3.143 If a drug is fat soluble, then it is likely to \_\_\_\_\_.
- A. cross from the spinal cord into the brain
  - B. cross from the hindbrain into the forebrain
  - C. cross from the arteries to the veins
  - D. cross from the blood into the brain

2 p. 79 Ans: D

- 3.144 Which drug easily passes into the brain from the bloodstream?
- A. alcohol
  - B. cocaine
  - C. barbiturates
  - D. all of the above

2 p. 79 Ans: D

- 3.145 Which drug is the LEAST likely to cross the blood-brain barrier?
- A. alcohol
  - B. barbiturates
  - C. nicotine
  - D. penicillin

3 p. 79 Ans: D

- 3.146 This common antibiotic treatment can only be used for infections outside the brain.
- A. sulfamide
  - B. penicillin
  - C. clarithromycin
  - D. azithromycin

3 p. 79 Ans: B

- 3.147 L-dopa is administered instead of dopamine to treat Parkinson's disease because \_\_\_\_\_.
- A. it produces fewer side effects
  - B. it crosses the blood-brain barrier more easily than dopamine
  - C. it can metabolize better into norepinephrine
  - D. none of the above

3 p. 80 Ans: B

3.148 You can facilitate the crossing of the blood-brain barrier by combining protein-based drugs with \_\_\_\_\_.

- A. another protein
- B. a fatty acid
- C. a derivative of dopamine
- D. a substance decreasing fat-solubility

3 p. 80 Ans: B

3.149 Which type of drug tolerance depends upon processes in the liver?

- A. metabolic tolerance
- B. pharmacodynamic tolerance
- C. cellular tolerance
- D. behavioral tolerance

1 p. 80 Ans: A

3.150 Which type of drug tolerance depends upon processes in the neuron?

- A. metabolic tolerance
- B. pharmacodynamic tolerance
- C. pharmacokinetic tolerance
- D. behavioral tolerance

2 p. 80 Ans: B

3.151 A decline in the sensitivity of receptors underlies which kind of tolerance?

- A. metabolic tolerance
- B. cellular tolerance
- C. dispositional tolerance
- D. behavioral tolerance

2 p. 80 Ans: B

3.152 Drug A and Drug B activate the same types of receptor sites. After repeated using of Drug A, Drug B would produce a \_\_\_\_\_ effect.

- A. stronger
- B. equivalent
- C. weaker
- D. cannot be determined from the above information

2 p. 81 Ans: B

3.153 The nucleus accumbens in the brain appears to be associated with what feature of many psychoactive drugs?

- A. their sedative (sleep-inducing) effects
- B. their stimulating effects
- C. their rewarding or reinforcing effects
- D. their hallucinogenic effects

2 p. 81 Ans: C

3.154 The pattern of human behavior that characterizes psychological dependence closely parallels \_\_\_\_\_.

- A. hoarding behavior in animals
- B. self-administration behavior in animals
- C. self-grooming behavior in animals
- D. epileptic seizures in animals

2 p. 81 Ans: B

3.155 The rewarding or reinforcing effects of amphetamines, cocaine, and heroin have been associated



with the effect on which major neurotransmitter?

- A. acetylcholine
- B. serotonin
- C. GABA
- D. dopamine

**2 p. 81 Ans: D**

3.156 Analogy: Dopamine is to craving as GABA is to \_\_\_\_\_.

- A. depression
- B. reduction of epileptic seizures
- C. schizophrenia
- D. separation anxiety during childhood

**3 p. 81 Ans: B**

3.157 Activity in the nucleus accumbens is related to \_\_\_\_\_.

- A. hallucinogenic drug effects
- B. sleep-inducing drug effects
- C. panic-inducing drug effects
- D. feelings of craving for certain psychoactive drugs

**3 p. 81 Ans: D**

3.158 The nucleus accumbens is in the \_\_\_\_\_.

- A. midbrain
- B. medulla
- C. cerebellum
- D. limbic system

**2 p. 81 Ans: D**

3.159 Which of the following statements is NOT true?

- A. Involvement with the nucleus accumbens has been linked to compulsive gambling and compulsive eating.
- B. Protein-based drugs can be mixed with fatty acids to allow them to pass through the blood brain barrier.
- C. Dopamine cannot cross through the blood brain barrier.
- D. Individual differences in dopamine receptor concentrations are partly environmentally based.

**3 pp. 81 Ans: D**

3.160 It is estimated that genetics account for about \_\_\_\_ percent of the inclination to begin smoking, and for about \_\_\_\_ percent of the ability to quit.

- A. 10; 15
- B. 75; 54
- C. 20; 31
- D. 54; 75

**3 p. 81 Ans: B**

3.161 In a recent study, twelve out of thirteen former cigarette smokers with brain damage to the \_\_\_\_\_ report that it was easier to quit smoking, whereas only four out of nineteen people with damage that did *not* include this area were able to do so.

- A. insula
- B. cerebellum
- C. medulla
- D. pons

**2 p. 82 Ans: A**

3.162 Drug effects are considered to be a three-way interaction of the drug's pharmacological properties with \_\_\_\_\_.

- A. set and stature
- B. set and setting
- C. set and time of day
- D. set and season

1 p. 82 Ans: B

3.163 Individual characteristics of the drug-taker or environmental conditions will have little influence on drug effects when \_\_\_\_\_.

- A. the drug is relatively bad-tasting
- B. the temperature is above 80 degrees Fahrenheit
- C. the drug-taker is younger than twelve
- D. the drug dose is relatively high

2 p. 83 Ans: D

3.164 Expectations about a drug effect determine the extent to which \_\_\_\_\_ occurs.

- A. the placebo effect
- B. the dosage-weight interaction
- C. the blood-brain barrier effect
- D. the gender-weight interaction

2 p. 83 Ans: A

3.165 If a placebo effect occurs, a completely inert substance \_\_\_\_\_.

- A. will have no effect whatsoever
- B. will have a reduced effect
- C. will have an effect
- D. will likely produce a lethal response

1 p. 83 Ans: C

3.166 Placebo effects are \_\_\_\_\_.

- A. psychological but not physical
- B. physical but not psychological
- C. neither physical nor psychological
- D. physical, psychological, or both

3 p. 83 Ans: D

3.167 The placebo effect in morphine administrations is \_\_\_\_\_.

- A. substantial
- B. relatively minor
- C. non-existent
- D. dependent upon the degree of fat solubility

1 p. 84 Ans: A

3.168 A possible determinant of whether a placebo effect will occur is \_\_\_\_\_.

- A. the enthusiasm of the physician prescribing it
- B. the attractiveness of the packaging
- C. information that other people have been helped
- D. all of the above

3 p. 84 Ans: D

3.169 Research has shown that if a doctor has negative attitudes concerning a drug, the effect of the drug on the patient is more likely to result in \_\_\_\_\_.

- A. the most benefits of the drug
- B. no effect at all
- C. the least benefits of the drug
- D. dependence on the drug

2 p. 84 Ans: C

3.170 The development of skin rashes when people believe they have been exposed to fake poison ivy is a likely consequence of \_\_\_\_\_.

- A. hyperadditive interactions between drugs
- B. the placebo effect
- C. the classical conditioning effect
- D. the nucleus accumbens effect

**2 p. 84 Ans: B**

3.171 In order for a possible placebo effect to be evaluated, \_\_\_\_\_.

- A. the placebo drug must look different from the real drug
- B. the placebo drug must be identical in appearance to the real drug
- C. it does not matter what the placebo drug looks like
- D. the individual must know ahead of time that a placebo is being used

**2 p. 84 Ans: B**

3.172 An active placebo is a \_\_\_\_\_.

- A. drug that actually has active ingredients in it
- B. drug that is inert but looks identical to the one with active ingredients
- C. drug that is inert but looks different from the one with active ingredients
- D. drug that has active ingredients in it and looks physically attractive

**2 p. 85 Ans: B**

3.173 An effective placebo to a well-known red pill containing antianxiety medication would be what color?

- A. a complementary color to red (in this case, green)
- B. white (colorless)
- C. black and white so that there would be no association with color red
- D. red

**1 p. 85 Ans: D**

3.174 In a double-blind procedure, knowledge about whether a drug or a placebo is being administered is withheld from \_\_\_\_\_.

- A. the individual receiving the drug but not the person administering it
- B. the individual administering the drug but not the person receiving it
- C. both the individual administering the drug and the person receiving it
- D. neither the individual administering nor the person receiving a drug

**2 p. 85 Ans: C**

3.175 A major feature of drug studies that is helpful in evaluating whether a new medication has genuine benefits is \_\_\_\_\_.

- A. media coverage of the results from past studies
- B. a double-blind procedure
- C. information concerning whether or not drug interactions occur
- D. information concerning whether or not a major neurotransmitter is involved

**2 p. 85 Ans: B**