

## Learning Objectives

### Basics of Pharmacology

1. Define receptors
2. Know what agonists and antagonists do when they bind the receptors
3. Differentiate receptor and inert binding sites from each other
4. Know which part of the receptor competitive inhibitors, allosteric activators and allosteric inhibitors bind and what is the result of binding
5. Know the meaning of permeation
6. Understand the concepts of aqueous diffusion, lipid diffusion, transport by special carriers and endocytosis/exocytosis
7. Know which factors influence the absorption of drugs;
8. Understand the concept of bioavailability;
9. Know the common routes of administration;
10. Recall which route of administration has the optimal bioavailability;
11. Recall which route of administration is associated with first pass metabolism;
12. Understand the concept of first-pass metabolism;
13. Know the determinants of drug distribution;
14. Understand the concept of volume of distribution;
15. Calculate the volume of distribution;
16. Understand the concept of metabolism;
17. Distinguish distribution and elimination phases;
18. Know which drugs need acute toxicity testing;
19. Understand the terms: mutagenic, carcinogenic, teratogenic;
20. Understand the dose-response relationships; be able to identify  $EC_{50}$  and  $E_{max}$  on curves;
21. Understand the concepts of efficacy and potency;
22. Know the effect of competitive antagonist in presence of full agonist; Be able to recall the shift on a dose-response curve;
23. Know the effect of competitive antagonist in presence of full agonist;
24. Understand the concepts of median effective, median toxic and median lethal doses.
25. Read the quantal dose-response plots and bell-shaped curves and identify  $ED_{50}$  and  $LD_{50}$  on it.
26. Know what is a therapeutic window and what it means clinically to have a wide or narrow therapeutic window;
27. Know what is therapeutic index and what it means to have a high or low therapeutic index;
28. Know 5 types of signaling mechanisms;
29. Know the concepts of tachyphylaxis and receptor upregulation and downregulation; Be able to identify which ones of them are long-term/short-term.
30. Know the meaning of an effective drug concentration;
31. Understand volume of distribution; be able to recall formula and calculate accordingly;
32. Know the effect of plasma protein binding or tissue protein binding on  $V_d$ .
33. Understand the concept of clearance; be able to recall the formula and calculate accordingly;
34. Understand the concept of half-life;
35. Understand the concept of steady state; Understand the concept of bioavailability;
36. Know which route of administration has the optimal bioavailability;

37. Know the factors that influence bioavailability;
38. Understand the concept of therapeutic window; Know how its width correlates with drug safety;
39. Understand different effects of biotransformation on drugs;
40. Name Phase I reactions; Know what are the characteristics of metabolites made by these reactions;
41. Name phase II reactions; Know what are the characteristics of metabolites made by these reactions;
42. Know what are important sites of drug metabolism;
43. Name the determinants of biotransformation rate;
44. Recall anatomic divisions (Parasympathetic, sympathetic, enteric), location of ganglia and characteristics of Autonomic nervous system (difference in terms of length of pre and postganglionic nerves)
45. Recall which receptors respond to autonomic transmitters and drugs but receive no innervation
46. Name primary neurotransmitters of parasympathetic and sympathetic nervous system and recall exceptions (thermoregulatory sweat glands)
47. List steps of Acetylcholine synthesis, storage and release with corresponding drugs that block this steps.
48. Understand process of docking and recall proteins that mediate it
49. Understand process of termination of action of acetylcholine and know the name of enzyme that cleaves it.
50. List steps of Norepinephrine synthesis, storage and release with corresponding drugs that block this steps.
51. Differentiate between process of termination of action of Acetylcholine and Norepinephrine
52. Name cotransmitters released together with primary neurotransmitters
53. Recall types of cholinergic receptors, Adrenoreceptors and Dopaminergic receptors, their location, secondary messenger systems that they use for signal transmission and effects of their activation/inhibition
54. Recall substances that inhibit transmitter release, transmitter uptake after release
55. Recall effects of Ganglion blockade
56. Name different receptors and response to their activation/inhibition in parts of an eye: accommodation, pupil size changes
57. Differentiate between actions of direct and indirect cholinomimetic agonists
58. Know which cholinomimetic agents have shortest/longest duration of action
59. Name Direct-acting cholinomimetic agents and
60. Name Indirect acting cholinomimetic agents and
61. List cholinergic receptors
62. Understand why and how the tissue and organ level effects of nicotinic ganglionic stimulation depend on the autonomic innervation of the organ
63. Describe all symptoms of cholinergic toxicity
64. Describe mechanism of action of Pralidoxime and meaning of enzyme "Aging"
65. Recall drug used for diagnosis of Myasthenia
66. Describe Difference between Malathion and Parathion, clinical use of malathion
67. Name antimuscarinic drugs
68. Name antinicotinic agents
69. Name cholinesterase regenerator, its mechanism of action and clinical use
70. Describe effects of muscarinic blocking drugs on CNS, Eye, Bronchi, GI and GU tracts, Heart, Blood vessels, Glands and skeletal muscle and which receptors are blocked

71. Student must know all predictable and other toxicities associated with Atropine (anticholinergic) toxicity
72. Recall treatment of atropine toxicity
73. Name contraindications to the use of antimuscarinic agents
74. Name ganglion blocking drugs and their effect on major organ systems.
75. Neuromuscular blocking drugs
76. Know the difference between mechanism of action of Depolarizing and Nondepolarizing neuromuscular blockers from the standpoint of tetanic and post-tetanic twitch strength.
77. Name the types of adrenoreceptors; Know their mechanism of action;
78. Know the difference between concepts of direct and indirect acting sympathomimetics;
79. Name examples of indirect acting sympathomimetics and explain their mechanism of action;
80. Know how catecholamines are metabolized;
81. Know which route of administration is optimal for direct adrenoreceptor agonists;
82. Know which route of administration is optimal for amphetamines;
83. Explain how tyramine interacts with MAO inhibitors;
84. Know CNS effects of sympathomimetic drugs;
85. Understand effects of sympathomimetic drugs on eyes;
86. Understand effects of sympathomimetic drugs on bronchi;
87. Understand effects of sympathomimetic drugs on GI tract;
88. Location of different sympathetic receptors in vascular beds;
89. Understand effects of sympathomimetic drugs on heart;
90. Understand net cardiovascular actions of sympathomimetic drugs;
91. Metabolic and hormonal effects of sympathomimetic drugs;
92. Know the treatment of anaphylaxis;
93. Know the CNS indications of sympathomimetic drugs;
94. Know the eye related indications of sympathomimetic drugs;
95. Name short-acting and long-acting sympathomimetics used for asthma treatment;
96. Know cardiovascular indications of sympathomimetic drugs;
97. Know indications and side effects of beta2 agonists in pregnant women;
98. Know GU indications of sympathomimetic drugs;
99. Understand toxicity of sympathomimetic drugs
100. Name primary subgroups of Adrenoreceptor antagonists
101. Name nonselective alpha receptor blockers
102. Describe Toxicity of selective and nonselective alpha receptor blockers
103. Explain most common cardiovascular effects of nonselective alpha blockers
104. Name beta 1 receptor blockers
105. Name nonselective beta receptor blockers
106. Name beta blockers who have inverse agonist action
107. Recall which beta blockers are short acting and which are long acting
108. List drugs that have both, alpha and beta receptor blocking effect
109. Recall toxicity of beta blockers
110. List 4 major groups of antihypertensive drugs, and give examples of drugs in each group. (Renin inhibitors are not considered an independent major group; can you name the one available drug that acts by this mechanism?).
111. Describe the compensatory responses, if any, to each of the 4 major types of antihypertensive drugs.

112. List the major sites of action of sympathoplegic drugs in research or clinical use, and give examples of drugs that act at each site.
113. List the 4 mechanisms of action of vasodilator drugs.
114. List the major antihypertensive vasodilator drugs and describe their effects.
115. Describe the differences between the 2 types of angiotensin antagonists.
116. List the major toxicities of the prototype antihypertensive agents.
117. Identify the major excitatory and inhibitory CNS neurotransmitters in the CNS.
118. Identify the sites of drug action at synapses and the mechanisms by which drugs modulate synaptic transmission.
119. Give an example of a CNS drug that influences neurotransmitter functions at the level of (a) synthesis, (b) metabolism, (c) release, (d) reuptake, and (e) receptor.
120. Identify major drugs in each sedative-hypnotic subgroup.
121. Recall the significant pharmacokinetic features of the sedative-hypnotic drugs commonly used for treatment of anxiety and sleep disorders.
122. Describe the proposed mechanisms of action of benzodiazepines, barbiturates, and zolpidem.
123. List the clinical uses and adverse effects of the major sedative-hypnotics.
124. Identify the distinctive properties of buspirone, eszopiclone, ramelteon, zaleplon, and zolpidem.
125. Describe the symptoms and management of overdose of sedative-hypnotics and withdrawal from physiologic dependence.
126. Name the major inhalation anesthetic agents and identify their pharmacodynamic and pharmacokinetic properties.
127. Describe what is meant by the terms (1) blood:gas partition coefficient and (2) minimum alveolar anesthetic concentration.
128. Identify proposed molecular targets for the actions of anesthetic drugs.
129. Describe how the blood:gas partition coefficient of an inhalation anesthetic influences its speed of onset of anesthesia and its recovery time.
130. Identify the commonly used intravenous anesthetics and list their main pharmacokinetic and pharmacodynamics characteristics.
131. Describe the mechanism of action of local anesthetics.
132. Know what is meant by the terms “use-dependent blockade” and “state-dependent blockade.”
133. Explain the relationship among tissue pH, drug pK, and the rate of onset of local anesthetic action.
134. List 4 factors that determine the susceptibility of nerve fibers to local anesthetic blockade.
135. Describe the major toxic effects of the local anesthetics.
136. Identify 3 opioid receptor subtypes and describe 2 ionic mechanisms that result from their activation.
137. Name the major opioid agonists, rank them in terms of analgesic efficacy, and identify specific dynamic or kinetic characteristics.

138. Describe the cardinal signs and treatment of opioid drug overdose and of the withdrawal syndrome.
139. List acute and chronic adverse effects of opioid analgesics.
140. Identify an opioid receptor antagonist and a mixed agonist-antagonist.
141. List the major organ system effects of histamine and serotonin.
142. Describe the pharmacology of the 3 subgroups of H1 antihistamines, list prototypical agents for each subgroup
143. Describe the pharmacology of the H2 antihistamines; name 2 members of this group.
144. Describe the effects of NSAIDs on prostaglandin synthesis.
145. Contrast the functions of COX-1 and COX-2.
146. Compare the actions and toxicity of aspirin, the older nonselective NSAIDs, and the COX-2-selective drugs.
147. Explain why several of the highly selective COX-2 inhibitors have been withdrawn from the market.
148. Describe the toxic effects of aspirin.
149. Describe the effects and the major toxicity of acetaminophen.
150. Describe the major naturally occurring glucocorticosteroid and its actions.
151. List several synthetic glucocorticoids, and describe differences between these agents and the naturally occurring hormone.
152. Describe the actions of the naturally occurring mineralocorticoid and 1 synthetic agent in this subgroup.
153. List the indications for the use of corticosteroids in adrenal and nonadrenal disorders.
154. Name 3 drugs that interfere with the action or synthesis of corticosteroids, and, for each, describe its mechanism of action.
155. Describe the mechanism of antibacterial action of beta-lactam antibiotics.
156. Describe 3 mechanisms underlying the resistance of bacteria to beta-lactam antibiotics.
157. Identify the prototype drugs in each subclass of penicillins, and describe their antibacterial activity and clinical uses.
158. Identify the 4 subclasses of cephalosporins, and describe their antibacterial activities and clinical uses.
159. List the major adverse effects of the penicillins and the cephalosporins.
160. Identify the important features of aztreonam, imipenem, and meropenem.
161. Describe the clinical uses and toxicities of vancomycin.
162. Explain how these agents inhibit bacterial protein synthesis.
163. Identify the primary mechanisms of resistance to each of these drug classes.
164. Name the most important agents in each drug class, and list 3 clinical uses of each.
165. Recall distinctive pharmacokinetic features of the major drugs.
166. List the characteristic toxic effects of the major drugs in each class.
167. Describe 3 actions of aminoglycosides on protein synthesis and 2 mechanisms of resistance to this class of drugs.
168. List the major clinical applications of aminoglycosides and identify their 2 main toxicities.

169. Describe aminoglycoside pharmacokinetic characteristics with reference to their renal clearance and potential toxicity.
170. Understand time-dependent and concentration-dependent killing actions of antibiotics and what is meant by postantibiotic effect.
171. Describe how sulfonamides and trimethoprim affect bacterial folic acid synthesis and how resistance to the antifolate drugs occurs.
172. Identify major clinical uses of sulfonamides and trimethoprim, singly and in combination, and describe their characteristic pharmacokinetic properties and toxic effects.
173. Describe how fluoroquinolones inhibit nucleic acid synthesis and identify mechanisms involved in bacterial resistance to these agents.
174. List the major clinical uses of fluoroquinolones and describe their characteristic pharmacokinetic properties and toxic effects.
175. List 5 special problems associated with chemotherapy of mycobacterial infections.
176. Identify the characteristic pharmacodynamic and pharmacokinetic properties of isoniazid and rifampin.
177. List the typical adverse effects of ethambutol, pyrazinamide, and streptomycin.
178. Describe the standard protocols for drug management of latent tuberculosis, pulmonary tuberculosis, and multidrug-resistant tuberculosis.
179. Identify the drugs used in leprosy and in the prophylaxis and treatment of *M. avium-intracellulare* complex disease.
180. Describe the mechanisms of action of the azole, polyene, and echinocandin antifungal drugs.
181. Identify the clinical uses of amphotericin B, flucytosine, individual azoles, caspofungin, griseofulvin, and terbinafine.
182. Describe the pharmacokinetics and toxicities of amphotericin B.
183. Describe the pharmacokinetics, toxicities, and drug interactions of the azoles.
184. Identify the main topical antifungal agents.
185. Identify the clinical uses of metronidazole and describe its pharmacokinetics and toxicities.
186. Identify the major urinary antiseptics and their characteristic adverse effects.