General Pharmacology
Learning Objectives

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. Understand the Fick's law of diffusion _ be able to identify which values increase and which one's decrease the rate of drug absorption;
8. Differentiate charged and uncharged molecules in terms of aqueous and lipid solubility;
9. Understand the Henderson-Hasselbach equation: what it can be used for and how;
10. Know how protonation/deprotonation affects ionization of weak acids and bases;
11. Clinically correlate ionization of weak acids and basis with renal excretion of drugs;
12. Know which factors influence the absorption of drugs;
13. Understand the concept of bioavailability;
14. Know the common routes of administration;
15. Recall which route of administration has the optimal bioavailability;
16. Recall which route of administration is associated with first pass metabolism;
17. Understand the concept of first-pass metabolism;
18. Know the determinants of drug distribution;
19. Understand the concept of volume of distribution;
20. Calculate the volume of distribution;
21. Know the percentages of total body water, intracellular water and extracellular water;
22. Understand the concept of metabolism;
23. Know the difference between excretion and elimination;
24. Understand what are the effects that metabolism can have on different drugs;
25. Differentiate first-order kinetics from zero order kinetics: understand what is the difference between their rates of elimination and half-lives;
26. Identify the graphs of zero-order vs. first order kinetics;
27. Recall the drugs that have zero-order kinetics;
28. Distinguish distribution and elimination phases;
29. Know which drugs need acute toxicity testing;
30. Know types of animal tests;
31. Know the categories of drug safety in pregnancy - be able to identify how safe the drug is based on its category;
32. Understand the terms: mutagenic, carcinogenic, teratogenic;
33. Understand the terms: single-blind study, double blind study;
34. Know what Ames test is and what it is used for;
35. Know what dominant lethal test is;

36. Know all four phases of clinical trials: purpose of each phase, approximate amounts of participants, target groups.
37. Understand the concept of adaptive clinical trials.
38. Know the meaning of orphan drugs.

39. Understand the dose-response relationships; be able to identify EC50 and Emax on curves;
40. Understand the concepts of efficacy and potency; be sure to know the pattern of their association with EC50 and Emax values;
41. Know the effect of competitive antagonist in presence of full agonist; Be able to recall the shift on a dose-response curve; be able to recall the effect of a noncompetitive antagonist on EC50 and/or Emax and therefore on potency and/or efficacy;
42. Know the effect of competitive antagonist in presence of full agonist; Be able to recall the shift on a dose-response curve; be able to recall the effect of a noncompetitive antagonist on EC50 and/or Emax and therefore on potency and/or efficacy;
43. Know the concepts of inverse agonist, full agonist, partial agonist, neutral antagonist and there Log Dose activity curves;
44. Understand the concepts of biased agonist, competitive antagonist, irreversible antagonist, physiologic antagonist, chemical antagonist;
45. Know the meaning of constitutive activity;
46. Understand the concepts of median effective, median toxic and median lethal doses.
47. Read the quantal dose-response plots and bell-shaped curves and identify ED50 and LD50 on it.
48. Know what is a therapeutic window and what it means clinically to have a wide or narrow therapeutic window;
49. Know what is therapeutic index and what it means to have a high or low therapeutic index;
50. Know 5 types of signaling mechanisms; Be able to identify which type of receptor is used by steroids, vitamin D, nitric oxide, insulin, EGF.
51. Know the concepts of tachyphylaxis and receptor upregulation and downregulation; Be able to identify which ones of them are long-term/short-term.
52. Know the meaning of an effective drug concentration;
53. Understand volume of distribution; be able to recall formula and calculate accordingely;
54. Understand how the Vd changes in case of liver disease and kidney disease.
55. Know the effect of plasma protein binding or tissue protein binding on Vd.
56. Understand the concept of clearance; be able to recall the formula and calculate accordingely;
57. Understand the concept of half-life; be-able to recall the formula and calculate accordingely; be able to calculate the dose patient took or current plasma concentration of the drug using the udnerstanding of half-life;
58. Understand the concept of steady state; be able to name the amount of half-lives needed tor each a steady state;
59. Understand the concept of bioavailability;
60. Know which route of administration has the optimal bioavailability;

61. Know the factors that influence bioavailability;
62. Understand the concept of area under the curve;
63. Understand the concept of extraction ratio;
64. Recall loading dose formula and calculate accordingely;
65. Recall maintenance dose formula and calculate accordingely;
66. Understand the concept of therapeutic window; Know how its width correlates with drug safety;
67. Know the formula of corected dosage in patients with altered clearance in case of renal impairment;
68. Understand different effects of biotransformation on drugs;
69. Name Phase I reactions; Know what are the characteristics of metabolites made by these reactions;
70. Name phase II reactions; Know what are the characteristics of metabolites made by these reactions;
71. Know what are important sites of drug metabolism;
72. Name the determinants of biotransformation rate;
73. define suicide inhibitors;
74. Know what are MDR-1 proteins and where they are commonly seen;
75. Know high yield CYP correlations; Be able to identify which drugs are CYP inhibitors or CYP inducers and which ones are metabolised by CYP enzymes;
76. Understand the concept of toxic metabolism using an example of acetaminophen;
77. Understand the concept of personalized medicine;
78. Understand how gene polymorphisms may effect the drug metabolism;
79. Recall the information given on table 5-1, columns 1 and 3;
80. Unerstand the importance of HLA polymorphisms;
81. Know the importance of P-glycoprotein;
82. Name the drugs that are contraindicated in enhanced metabolizers of the HLA-B*57:01 type.
83. 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)
84. Name the cranial nerves that are part of parasympathetic nervous system
85. Recall which receptors respond to autonomic transmitters and drugs but receive no innervation
86. Name primary neurotransmitters of parasympathetic and sympathetic nervous system and recall exceptions (thermoregulatory sweat glands)
87. List steps of Acetylcholine synthesis, storage and release with corresponding drugs that block this steps.
88. Understand process of docking and recall proteins that mediate it
89. Understand process of termination of action of acetylcholine and know the name of enzyme that cleaves it.
90. List steps of Norepinephrine synthesis, storage and release with corresponding drugs that block this steps.

91. Differentiate between process of termination of action of Acetylcholine and Norepinephrine
92. Name cotransmitters released together with primary neurotransmitters
93. Recall types of cholinoreceptors, Adrenoreceptors and Dopaminergic receptors, their location, secondary messenger systems that they use for signal transmission and effects of their activation/inhibition
    a. Predict effects of these inhibitors on the function of major organ systems (cardiovascular, respiratory, GI, GU, reproductive, exocrine, endocrine, CNS, skeletal muscle)
94. Have general understanding of what nonadrenergic, noncholinergic transmission means
95. Recall substances that inhibit transmitter release, transmitter uptake after release
    a. describe the action of several toxins that affect nerve function: tetrodotoxin, saxitoxin, botulinum toxin and Iatrotoxin
96. Describe the control of blood pressure
    a. Baroreceptor neural reflex
    b. Renin-Aldosterone-Angiotensin hormonal response
97. Describe baroreceptor response for the following conditions
    a. blood loss
    b. administration of vasodilator
    c. a vasoconstrictor
    d. a cardiac stimulant
    e. cardiac depressant
98. Recall effects of Ganglion blockade
99. Name different receptors and response to their activation/inhibition in parts of an eye: accommodation, pupil size changes
100. Differentiate between actions of direct and indirect cholinomimetic agonists
101. Know which cholinomimetic agents have shortest/longest duration of action
102. Name Direct-acting cholinomimetic agents and
    a. their spectrum of action (muscarinic,nicotinic or activation of both receptors)
    b. their clinical use
    c. key pharmacokinetic functions (short./long acting, can cross Blood-Brain Barrier or not, degraded by cholinesterase or not)
    d. mechanism of action
103. Name Indirect acting cholinomimetic agents and
    a. their spectrum of action (muscarinic,nicotinic or activation of both receptors)
    b. their clinical use
    c. key pharmacokinetic functions (short./long acting, can cross Blood-Brain Barrier or not)
    d. mechanism of action
104. List cholinergic receptors

a. their second messenger systems

105. Understand why and how the tissue and organ level effects of nicotinic ganglionic stimulation depend on the autonomic innervation of the organ
106. Understand mechanism of vasodilation and sweat gland activation

107. Describe all symptoms of cholinergic toxicity
    a. Differentiate between muscarinic and nicotinic toxicity
    b. Name drug used to reverse muscarinic toxicity and drug that reverses nicotinic effects
108. Describe mechanism of action of Pralidoxime and meaning of enzyme "Aging"
109. Recall drug used for diagnosis of Myasthenia
    a. used for differentiating Myasthenic and Cholinergic crises
110. Describe Difference between Malathion and Parathion, clinical use of malathion
111. Name antimuscarinic drugs
    a. their relative selectivity to specific receptors
    b. which organ systems do they affect
    c. clinical use
112. Name antinicotinic agents

a. whether they block ganglion or neuromuscular junction signal transmittion
b. clinical use

113. Name cholinesterase regenerator, its mechanism of action and clinical use
114. 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
115. Student must know all predictable and other toxicities associated with Atropine (anticholinergic) toxicity
116. Recall treatment of atropine toxicity
117. Name contraindications to the use of antimuscarinic agents
118. Name ganglion blocking drugs and their effect on major organ systems.
119. Neuromuscular blocking drugs
120. Know the difference between mechanis of action of Depolirizing and Nondepolirizing neuromuscular blockers from the standpoint of tetanic and post-tetanic twitch strength.
121. Recall prototype drug for depolirizing NM blockers
    a. Its pharmacokinetic properties
    b. mechanism of action
    c. Describe phase 1 and phase 2 of blockade
    d. Name which of this phases can be overcome by increased acetylcholine levels and which can become worse
    e. Its effects on cardiac muscarinic receptors, autonomic ganglia and histamine release
    f. Specific effects of succinylcholine in specific groups of patients (burn victims, peripheral nerve dysfunction, muscular dystrophy, spinal cord injury)
    g. possible aspiration of gastric contents
    h. Interaction of succinylcholine with other medications
122. List nondepolarizind agents
    a. Describe what phase of blockade does it have
    b. whether blockade can be reversed by increasing acetylcholine level or not
    c. mechanism of action
    d. Name which of these agent affects cardiac muscarinic receptors and how
    e. Name which of them is not used anymore because of toxic metabolite

123. Effects of aging and disease on nondepolarizing and depolarizing NM blocker action
124. Spasmolytic drugs
125. Student should be able to name drugs used for chronic spasms
    a. Their mechanism of action
    b. Specific clinical application
    c. side effects
126. Describe which electrolyte abnormality characterizes malignant hyperthermia
    a. Agent used to treat malignant hyperthermia
    b. Its mechanism of action
127. Name the types of adrenoreceptors; Know their mechanism of action; Know which tissues they are in (Table 9-1)
128. Know the difference between concepts of direct and indirect acting sympathomimetics;
129. Name examples of indirect acting sympathomimetics and explain their mechanism of action;
130. Know how catecholamines are metabolized;
131. Know which route of administration is optimal for direct adrenoreceptor agonists;
132. Know which route of administration is optimal for amphetamines;
133. Explain how tyramine interacts with MAO inhibitors;
134. Associate each type of adrenoreceptor with appropriate second messenger system;
135. Associate each type of dopamine receptor with appropriate second messenger system;
136. Know CNS effects of sympathomimetic drugs;
137. Understand effects of sympathomimetic drugs on eyes;
138. Understand effects of sympathomimetic drugs on bronchi;
139. Understand effects of sympathomimetic drugs on GI tract;
140. Understand effects of sympathomimetic drugs on GU tract;
141. Location of different sympathetic receptors in vascular beds;
142. Understand effects of sympathomimetic drugs on heart;
143. Understand net cardiovascular actions of sympathomimetic drugs;
144. Understand Figure 9-1; be able to identify a drug based on a figure;
145. Metabolic and hormonal effects of sympathomimetic drugs;
146. Know the treatment of anaphylaxis;
147. Know the CNS indications of sympathomimetic drugs;
148. Know the eye related indications of sympathomimetic drugs;
149. Name short-acting and long-acting symptahomimetics used for asthma treatment;
150. Know cardiovascular indications of sympathomimetic drugs;
151. Know indications and side effects of beta2 agonists in pregnant women;
152. Know GU indications of sympathomimetic drugs;
153. Understand toxicity of sympathomimetic drugs
154. Name primary subgroups of Adrenoreceptor antagonists
155. Name nonselective alpha receptor blockers
    a. Compare reversible and irreversible alpha blockers
    b. Clinical use
c. List selective alpha 1 receptor blockers, most common clinical application

156. Describe Toxicity of selective and nonselective alpha receptor blockers
157. Explain most common cardiovascular effects of nonselective alpha blockers
158. Explain "Epinephrine reversal" in a patient who has received an alpha blocker
    a. Compare to phenylephrine effect
159. Name beta 1 receptor blockers
    a. mechanism of action
    b. clinical application
160. Name nonselective beta receptor blockers
    a. mechanism of action
    b. clinical application
161. Name beta blockers who have inverse agonist action
162. Recall which beta blockers are short acting and which are long acting
163. List drugs that have both, alpha and beta receptor blocking effect
164. Recall toxicity of beta blockers
165. Name drugs used in glaucoma
    a. Mechanism of action
    b. Method of administration
166. List the major organ system effects of histamine and serotonin.
167. Describe the pharmacology of the 3 subgroups of H1 antihistamins, list prototypical agents for each subgroup
168. Describe the pharmacology of the H2 antihistamines; name 2 members of this group.
169. Describe the action and indication for the use of "triptans" such as sumatriptan.
170. Describe one 5-HT2 and one 5-HT3 antagonist and their major applications.
171. List 3 drugs currently approved for the treatment or prevention of obesity.
172. List the major organ system effects of the ergot alkaloids.
173. Describe the major clinical applications and toxicities of the ergot drugs.
174. List 3 important hyperthermic syndromes.
175. Name an antagonist of angiotensin II at its receptor and at least 2 drugs that reduce the formation of ANG II.
176. Outline the major effects of bradykinin and brain natriuretic peptide.
177. Describe the functions of converting enzyme (peptidyl dipeptidase, kininase II).
178. List 2 potent vasoconstrictor peptides.
179. Describe the effects of vasoactive intestinal peptide and substance P.
180. Describe the clinical applications of bosentan and aprepitant.
181. Describe the effects of NSAIDs on prostaglandin synthesis.
182. Contrast the functions of COX-1 and COX-2.
183. Compare the actions and toxicity of aspirin, the older nonselective NSAIDs, and the COX-2-selective drugs.
184. Explain why several of the highly selective COX-2 inhibitors have been withdrawn from the market.
185. Describe the toxic effects of aspirin.
186. Describe the effects and the major toxicity of acetaminophen.
187. Name 5 disease-modifying antirheumatic drugs (DMARDs) and describe their toxicity.

188. Explain why patients need to be screened for tuberculosis prior to initiating anti-TNFalpha-therapy.
189. Describe the major naturally occurring glucocorticosteroid and its actions.
190. List several synthetic glucocorticoids, and describe differences between these agents and the naturally occurring hormone.
191. Describe the actions of the naturally occurring mineralocorticoid and 1 synthetic agent in this subgroup.
192. List the indications for the use of corticosteroids in adrenal and nonadrenal disorders.
193. Name 3 drugs that interfere with the action or synthesis of corticosteroids, and, for each, describe its mechanism of action.
194. Describe strategies of asthma and COPD therapy.
195. List the major classes of drugs used in asthma and COPD.
196. Describe the mechanisms of action of these drug groups.
197. List the major adverse effects of the prototype drugs used in airways disease.
198. Sketch the biochemical pathway for thyroid hormone synthesis and release and indicate the sites of action of antithyroid drugs.
199. List the principal drugs for the treatment of hypothyroidism.
200. List the principal drugs for the treatment of hyperthyroidism and compare the onset and duration of their action.
201. Describe the major toxicities of thyroxine and the antithyroid drugs.
202. Describe the effects of insulin on hepatocytes, muscle, and adipose tissue.
203. List the types of insulin preparations and their durations of action.
204. Describe the major hazards of insulin therapy.
205. List the prototypes and describe the mechanisms of action, key pharmacokinetic features, and toxicities of the major classes of agents used to treat type 2 diabetes.
206. Give 3 examples of rational drug combinations for treatment of type 2 diabetes mellitus.
207. Describe the clinical uses of glucagon.
208. Describe the primary features of cell-mediated and humoral immunity
209. Name 7 immunosuppressants and, for each, describe the mechanism of action, clinical uses, and toxicities
210. Describe the mechanisms of action, clinical uses, and toxicities of antibodies used as immunosuppressants.
211. Identify the major cytokines and other immunomodulating agents and know their clinical applications.
212. Describe the different types of allergic reactions to drugs.